TRUE TO THE END.

Sir Abraham Hume Bart.

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A
PLAN
OF A COURSE OF
CHEMICAL LECTURES,

BY
R. WATSON, D.D. F.R.S.
AND
REGIUS PROFESSOR OF DIVINITY
IN THE
UNIVERSITY OF CAMBRIDGE.

> *Rerum natura, ſacra ſua non ſimul tradit: Initiatos nos credimus, in veſtibulo ejus hæremus. Illa Arcana non promiſcuè nec omnibus patent; reducta et in inferiore ſacrario clauſa ſunt. Ex quibus aliud hæc ætas, aliud quæ poſt nos ſubibit, adſpiciet.*

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&c. &c. &c.

AS
A SINCERE TESTIMONY OF
RESPECT AND GRATITUDE
FOR THE STIPEND, WHICH THE AUTHOR,
THROUGH
HIS LORDSHIP's RECOMMENDATION,
ENJOYED FROM THE CROWN AS
PROFESSOR OF CHEMISTRY
IN THE UNIVERSITY OF CAMBRIDGE,

THE
FOLLOWING PLAN OF CHEMICAL LECTURES

IS
MOST HUMBLY INSCRIBED AND DEDICATED
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The following is the Plan of Lectures which I intended to have read during the Courſe of the preſent Term, had not the important Office to which I have had the honour of being unanimouſly elected, prevented me. I meant to have prefixed a Preface containing a ſhort Hiſtory of the Riſe and Progreſs of Chemiſtry; an account of the recent Diſcoveries foreign and domeſtic which have been made in this Art; and of the preſent Deſiderata in it; together with ſome animadverſions on the commonly received doctrine of Chemical Elements; but I cannot, at this time and in my preſent ſituation, perſuade myſelf to review what I have written upon theſe Subjects. I take my leave of Chemiſtry with ſome regret: from no part of Phyſics have I received equal entertainment, or equal inſtruction. I feel a ſatiſfaction, however, in having been in ſome degree inſtrumental in acquiring for this Study the Protection of his Majeſty, and in recommending it to the notice of this Univerſity.

Trinity College, Nov. 15, 1771.

INTRODUCTION.

HISTORY of Chemiſtry, and of Alchemy.

Of the Elements of Chemiſtry commonly received — Earth, Air, Fire, Water.

Conjectures concerning the mutual convertibility of Chemical Elements.

Of the ſolidity, fluidity, fixity, and volatility of bodies in different degrees of heat.

Conjectures concerning the formation and nature of the Atmoſphere.

Calcination, Sublimation, Evaporation, Diſtillation per aſcenſum, per retortam, per deſcenſum, explained and exemplified.

Of the different degrees of heat required for the conducting of different operations: the terms Venter equinus, Balneum Maris vel Mariæ, Balneum vaporis, Capella vacua, Balneum cinerum, arenæ, limaturæ ferri, explained.

The heat of boiling homogeneous fluids in open veſſels, ſhewn to be incapable of Increaſe from an increaſe of fire.

The heat of boiling homogeneous fluids ſhewn to be greater or leſs, within certain limits, in proportion to the augmentation or diminution of the preſſure of the Atmoſphere, or other elaſtic fluid upon their ſurface.

A fluid contained in a veſſel expoſed to the action of boiling water for any length of time, does not acquire the heat of boiling water without it come in immediate contact with it.

The heat of boiling oil aſcertained, and the uſe of a Balneum Olei illuſtrated.

The Structure and Uſe of Simple, Reverberatory, Melting, Cupelling and other Furnaces explained.

The nature of the Inflammable Principle, Pabulum ignis, or Phlogiſton, enquired into from the Phænomena attending the Combuſtion of Vegetable Oil, Animal Fat, Vinous Spirits, Charcoal, and Metallic Subſtances.

The Earth obtained from the Combuſtion of the Phlogiſton of Metallic Subſtances converted into its primary Metallic Appearance by the Addition of Phlogiſton; exemplified in the Reduction of the Flowers of Zinc by Charcoal, and of Minium by Charcoal, by Animal Fat, and by Iron Filings. — The Identity of Phlogiſton inferred from the preceding Experiments.

Definition, and general Diviſion of ſaline Subſtances into Acid, Alcaline, and Neutral Salts.

Acid Salts diſtinguiſhed commonly from alcaline and neutral Salts by their Taſte, by efferveſcing with calcareous Earths, and by changing the blue Colour of Syrup of Violets, and other blue vegetable Infuſions into a red.

Alcaline Salts diſtinguiſhed from neutral Salts by Taſte, by efferveſcing with Acids, and by changing the blue Colour of Syrup of Violets into a green.

A neutral Salt made from a mixture of

an Acid and an Alcali. — The term Saturation explained.

The Vegetable fixed Alcali extracted from the aſhes of Charcoal by Solution and Filtration; and from Tartar by Combuſtion—Pearl-aſh—Pot-aſh—Salt of Tartar.

Salt of Tartar rendered Liquid by expoſure to the Air, improperly in that ſtate called Oil of Tartar per Deliquium.

Quantity of Water attracted from the Air by a given quantity of Salt of Tartar, in a given time, eſtimated by experiment.

The Mineral fixed Alcali extracted from the aſhes of the plant Kali, jointed Glaſswort, marſh Samphire, or Salicornia of Linnæus, and from Sea Tangle, &c. by Solution and Filtration, and its difference from the Vegetable fixed Alcali ſhewn.

Volatile and fixed Alcalies diſtinguiſhed from each other by the Smell, and by the different Colours produced in mixing them with a Solution of corroſive Sublimate. — Uncertainty of this Criterion remarked.

OF MINERALS.

Of the Pyrites and green Vitriol.

Natural Hiſtory of the Pyrites.

Sulphureo-ferrugineous Pyritæ from the Chalk pits of Cherry-hinton analyſed by Diſtillation—Sulphur,—Ferrugineous Reſiduum: Method of aſſaying any particular Species of the Pyrites for Sulphur.

Analyſis of Sulphur by Combuſtion — Phlogiſton — Volatile ſulphureous Acid: Method of obtaining the acid of Sulphur at Batterſea, and in other Places.

Iron-pyritæ deſulphurated by roaſting.

Green Vitriol extracted from the deſulphurated Iron-pyritæ by Elixation and Cryſtallization: Method of aſſaying any particular Species of the Pyrites for green Vitriol.

Iron-filings, Sulphur, and Water kneaded together; Intumeſcence, - Incaleſcence, - Incenſion of the Mixture.

Conjectures concerning the Origin of ſubterraneous Fires and Volcanos founded upon the preceding Experiment.

Green Vitriol extracted from the Reſiduum of the preceding Experiment.

Of the weathering, or ſpontaneous Decompoſition and ſimultaneous vitriolization, of the Pyrites.

Various Species of the Pyrites exhibited in a vitriolizing State.

Green Vitriol extracted from vitriolized Pyritæ.

Account of the principal green Vitriol Works in Great Britain.

Native green Vitriol - German - Engliſh.

Method of purifying green Vitriol from Copper, and of diſcovering whether it contains Copper.

Green Vitriol calcined to a white - yellow - and red Colour.

Calcined green Vitriol analyſed by Diſtillation - vitriolic Acid - ferrugineous Reſiduum or Colcothar.

Of the vitriolic Acid and its Combination with Water, with fixed, and with volatile alcaline Salts.

The vitriolic Acid of the preceding proceſs concentrated, or rectified by Diſtillation: Weak Acid, commonly called Spirit of Vitriol - Reſiduum, ſtrong Acid, improperly called Oil of Vitriol.

Degree of Heat ariſing from the Mixture of Oil of Vitriol and Water obſerved by a Thermometer: Proportions producing a Maximum of Heat aſcertained by Experiment.

Quantity of Water attracted from the Air by a given Quantity of Oil of Vitriol, in a given time, eſtimated by Experiment: Uſe of Oil of Vitriol as an Hygrometer.

Specific Gravity of Oil of Vitriol determined.

Equal Bulks of Oil of Vitriol and Water mixed together: ſpecific Gravity of the Mixture not equal to the mean ſpecific Gravity of the two Fluids.

Dr. Hook's Experiment, concerning the Penetration of Dimenſions in the Mixture of Oil of Vitriol and Water, conſidered.

Vitriolic Acid not abſorbed into the Pores of Water, as Muſſchenbroek and others have ſuppoſed.

Acid of Vitriol combined with the fixed alcaline Salt of Tartar - Tartarus vitriolatus made after Tachenius's Manner, - General Properties of vitriolated Tartar.

Sir Iſaac Newton's Theory concerning chemical Attraction ſtated and explained - Geoffroy's, Gellert's and other Tables of Affinity explained.

Acid of Vitriol combined with the fixed alcaline Salt of Kelp - Glauber's Sal Mirabilis, - General Properties of Glauber's Salt.

Acid of Vitriol combined with volatile Alcali - Sal ammoniacus ſecretus Glauberi; general Properties of this Salt.

Of the Combination of the vitriolic Acid with Earths.

Acid of Vitriol combined with Earth of Sal catharticus amarus - Hiſtory of Epſom Salts.

Acid of Vitriol combined with argillaceous Earths - Alum.

Natural Hiſtory of aluminous Ores.

Schiſtus aluminoſus crude, and calcined, from Yorkſhire and Lancaſhire.

Account of the principal Alum Works in England.

Method of aſſaying aluminous Mineræ.

Alum calcined - Alumen uſtum.

Alumen uſtum diſſolved in Water and cryſtalized.

Analyſis of Alum by Diſtillation - Vitriolic Acid - Reſiduum.

Analyſis of Alum by Precipitation with fixed alcaline Salt of Tartar - Vitriolated Tartar - Earth of Alum.

Account of the Experiments of Marggraf and Macquer upon the Earth of Alum.

Nature of argillaceous Earths - Conjectures concerning the Identity of argillaceous and vitrifiable Earths.

Acid of Vitriol combined with vitrifiable Earth.

Acid of Vitriol combined with calcareous Earth.

Natural Hiſtory of Plaſter-Stone, Alabaſter, Gypſum, Selenites.

Specimens of Plaſter-Stone from Montmartre near Paris, from Cornwall, Derbyſhire, Weſtmoreland, &c.

Specimens of Rhomboidal Selenites from Shotover Hill in Oxfordſhire, of ſtriated Gypſum from Derbyſhire, of Gypſum phoſphoreſcens from Bononia, &c.

Gypſeous Earth analyſed by boiling it with Salt of Tartar - vitriolated Tartar and calcareous Earth obtained therefrom.

Hiſtory of the Diſcovery of the Bononian Phoſphorus. - Experiments therewith.

Artificial Bononian Phoſphorus made from calcined Oyſter Shells and Flowers of Sulphur after Mr. Canton's Method - Account of his Experiments therewith.

Of the Combination of the vitriolic Acid with Phlogiſton, Spirits of Wine, and Oils.

Acid of Vitriol combined with Phlogiſton - Sulphur.

Natural Hiſtory of Sulphur.

Sulphur nativum, pellucidum et opacum, from Solfatara near Naples.

Sulphur nativum pulverulentum Aquis eﬄoreſcens, from the Baths of Aix-la-Chapelle.

Account of the different Methods of preparing crude Sulphur in Germany, Saxony, &c.

Sulphur purified by Sublimation - Flowers of Sulphur - Sulphur Slag.

Sulphur cryſtallized.

Spirit of Sulphur per Campanam - Various ways of obtaining it.

Acid of Vitriol changed into a volatile ſulphureous Acid, by the addition of Phlogiſton in a State of Diſſipation.

Volatile ſulphureous Acid combined with the fixed alcaline Salt of Tartar - Stahl's ſulphureous Salt.

Sulphureous Salt of Stahl changed into vitriolated Tartar by ſimple Expoſure to the Air, or by the addition of Oil of Vitriol.

Sulphur united with fixed alcaline Salt by Fuſion - Hepar Sulphuris.

Hepar Sulphuris changed into vitriolated Tartar by the Diſſipation of the Phlogiſton. Analyſis of Sulphur.

Vitriolated Tartar changed into Hepar Sulphuris by the addition of Phlogiſton - Syntheſis of Sulphur.

The Proportion of the conſtituent Parts of Sulphur deduced from the two preceding Experiments of Stahl.

Hepar Sulphuris digeſted in rectified Spirits of Wine - Tinctura Sulphuris.

Sulphur rendered ſoluble in Water, by boiling it with fixed alcaline Lixivia, or with lime Water.

Sulphur precipitated from the preceding

Solutions by weak Spirits of Vitriol - Lac Sulphuris - Sulphur præcipitatum.

Sulphur united with volatile alcaline Spirits by diſtilling it with Sal Ammoniac and Lime - Tinctura Sulphuris volatilis.

Action of Water and Acids upon Sulphur examined.

Remarks upon M. le Comte de Lauragais' Method of uniting Sulphur with Spirits of Wine.

Sulphur diſſolved in Oil of Turpentine. Balſamum Sulphuris terebinthinatum.

Sulphur diſſolved in Oil of Olives - Balſamum Sulphuris ſimplex.

Hiſtory of the Diſcovery of Homberg's Pyrophorus.

Various Pyrophori made from Alum, Glauber's Salt, &c. calcined in conjunction with Matters containing Phlogiſton.

Oil of Vitriol mixed with rectified Spirits of Wine - Phænomena attending the Commixtion - the Mixture diſtilled - Æther of Frobenius - Sulphureous Acid - Oil of Spirits of Wine - Artificial Reſin - Sulphur - Caput mortuum.

Specific Gravity of Æther determined.

Cold produced by the Evaporation of Æther - of Spirits of Wine - of alcaline Salts, &c.

Application of this principle of producing cold by Evaporation, to the cooling of Liquors, &c. in hot Climates.

Phænomena attending the Combuſtion of Æther.

Miſcibility of Æther with Water, in certain Proportions, proved.

The Characteriſtics of Æther, as diſtinguiſhed from Spirits of Wine, and from Eſſential Oils.

Oil of Vitriol mixed with Oil of Turpentine - Artificial Reſin reſulting therefrom: Proportions of the Ingredients which, cæteris paribus, produce the moſt ſolid Reſin.

The preceding artificial Reſin diſtilled - Sulphureous Acid - Oil - Sulphur - Caput mortuum.

Of Nitre.

Account of the different Methods of making Nitre in the Eaſt Indies, and in Europe.

Of the medium quantity of Nitre annually imported into Great Britain from the Eaſt Indies, and exported to various parts of Europe.

Crude Nitre extracted from nitrous Earths.

Crude Eaſt India Nitre purified from Sea Salt, and calcareous Earth.

Nitre from America.

Account of the attempts to make Nitre in England.

Analyſis of the Mother Water of Nitre.

Hiſtory of the medicinal Application of Magneſia alba.

Nitre analyſed by diſtilling it with calcined Vitriol - Acid of Nitre or Aqua Fortis - Reſiduum.

Reſiduum of the preceding Proceſs analyſed - vitriolated Tartar - ferrugineous Earth.

Acid of Nitre procured by diſtilling Nitre with Sand, Clay, Alum, &c.

Fuming Acid of Nitre procured by diſtilling Nitre with Oil of Vitriol - Reſiduum examined.

Fuming Acid of Nitre purified by diſtilling it with Nitre. Teſt of the Purity of Acid of Nitre.

Fuming Acid of Nitre mixed with Water - Change of Colour obſerved - Degree of Heat aſcertained.

Fuming Acid of Nitre mixed with Snow, and with powdered Ice - Degree of Cold aſcertained.

Fuming Acid of Nitre mixed with the Cryſtals of Kelp - Degree of Heat obſerved.

Diluted Acid of Nitre mixed with Cryſtals of Kelp - Degree of Cold obſerved.

Fuming Acid of Nitre ſimple, and combined with Oil of Vitriol mixed with various Oils - Inflammation produced thereby - Reſidua.

Enumeration of the various Oils which have been obſerved to take fire, to effervefce without taking fire, and which neither efferveſce nor take fire, when mixed with the fuming Acid of Nitre.

Acid of Nitre dulcified with rectified Spirits of Wine, by Diſtillation and Digeſtion.

Nitrous Æther made by ſpontaneous Diſtillation, and by Digeſtion.

Nitre alcaliſed by Fuſion.

Nitre alcaliſed by Charcoal - Clyſſus of Nitre.

Volatile Alcali in a concrete form ſeparated from the Clyſſus of Nitre.

Nitre detonated with Tartar in various proportions - white Flux - black Flux.

Nitre deflagrated with Sulphur - Sal Polychreſtus - Sal Prunellæ.

Pulvis fulminans made from Nitre, Salt of Tartar, and Sulphur. - Exploſion of Pulvis fulminans.

Hiſtory of the Invention of Gunpowder.

Gunpowder made from Nitre, Sulphur, and Charcoal - Account of the different Proportions of the Ingredients uſed in different Countries, and in different Works in England. - Beſt Proportions aſcertained.

Method of extracting Nitre from damaged Gunpowder at Woolwich, &c.

Gunpowder decompoſed. - The three conſtituent Parts exhibited ſeparate. - Method of detecting Frauds uſed in the Compoſition of Gunpowder explained.

Acid of Nitre combined with calcareous Earth - Calcareous Nitre - Phoſphorus Balduini.

Acid of Nitre combined with argillaceous Earth - Aluminous Nitre.

Acid of Nitre combined with the vegetable fixed Alcali - Regenerated Nitre.

Acid of Nitre combined with the mineral fixed Alcali - Quadrangular or cubic Nitre.

Acid of Nitre combined with volatile Alcali - Nitrous ſal Ammoniac.

Of the Uſe of Nitre in Agriculture.

The Uſe of Snow in fertilizing the ground, ſhewn not to depend upon the Nitre it is generally ſuppoſed to contain.

Of Sea Salt.

Natural Hiſtory of Sea Salt - Sal marinus, fontanus, foſſilis.

Hiſtory of the Diſcovery of foſſil Salt in England.

Account of the Method of preparing Sea Salt in different Parts of the World.

Of the different antiſeptic Powers of Sea Salt according to the different Proceſſes by which it is prepared.

Of the Bittern of Sea Salt.

Of the Method by which Epſom Salts, common Glauber Salts, and Magneſia, are extracted from the Bittern of Sea Salt at Lymington, and other Places.

Method of diſtinguiſhing the genuine Sal mirabilis Glauberi from the counterfeit of the Shops.

Analyſis of Sea-water, attempted.

Comte Marſigli's Artificial Sea Water.

M. de Francheville's Opinion, concerning the Saltneſs of the Sea, examined.

Mr. Boyle's Opinion, concerning the uniform Saltneſs of the Sea at different Depths, examined.

Account of various Attempts to edulcorate Sea Water.

Of Mr. Irving's late Attempt.

Of the teſts of the purity of diſtilled Sea Water.

Of the phoſphoric Quality of Sea Water in particular Places, and at particular Times in the ſame Place.

Mr. Canton's Experiments concerning the Cauſe of the Luminouſneſs of Sea Water.

Account of other Opinions concerning the ſame Subject.

Sea Salt diſſolved and cryſtallized.

Decrepitation and Fuſion of Sea Salt.

Sea Salt analyſed by diſtilling it with Acid of Vitriol after Glauber's Manner - Fuming Spirit of Salt - Reſiduum.

The Reſiduum of the preceding Proceſs analyſed, and the fixt alcaline Baſis of Sea Salt obtained therefrom after Marggraf's Method.

Glauber's fuming Spirit of Salt purified by diſtilling it with Sea Salt.

Sea Salt diſtilled with Vitriol, Clay, &c. - Acid of Sea Salt - Reſidua.

Acid of Sea Salt ſeparated from its alcaline Baſis by Acid of Nitre.

Acid of Sea Salt combined with calcareous Earth - Phoſphorus Hombergi.

Acid of Sea Salt combined with argillaceous Earth - Muriatic Alum.

Acid of Sea Salt combined with Earth of Sal catharticus amarus.

Acid of Sea Salt combined with fixed Alcali of Tartar - Sal Febrifugus Sylvii.

Acid of Sea Salt combined with Alcali of Kelp - Sea Salt regenerated.

Acid of Sea Salt combined with volatile Alcali - Artificial Sal Ammoniac.

Acid of Sea Salt dulcified by Diſtillation with Spirits of Wine.

Marine Æther made after the Marquis de Courtanvaux's Manner.

Aqua regia made by mixing together Acid of Sea Salt and Acid of Nitre.

Aqua regia made by diſſolving Sea Salt or Sal Ammoniac in Acid of Nitre - its Difference from the preceding Aqua regia, remarked.

Of Sea Salt as a Condiment, and as a Manure.

Of Sal Ammoniac.

Natural Hiſtory of Sal Ammoniac.

Method of making Sal Ammoniac in Egypt.

Method of making Sal Ammoniac in Europe.

Sal Ammoniacus glebofus from Solfaterra.

Sal Ammoniac purified by Sublimation.

Sal Ammoniac purified by Cryſtallization.

Sal Ammoniac diſſolved in Spirits of Wine.

Sal Ammoniac deflagrated with Nitre.

Sal Ammoniac analyſed by diſtilling it with the Acid of Vitriol, and of Nitre - Marine Acid - Reſidua.

Sal Ammoniac analyſed by diſtilling it with fixed Alcali - Volatile Alcali - Reſiduum.

The volatile alcaline Spirit of Sal Ammoniac procured by diſtilling it with Quicklime - Cauſtic Spirit of Sal Ammoniac.

The Reſiduum of the Proceſs examined - Oleum Calcis.

Volatile Alcaline Salt Spirit procured by diſtilling Sal Ammoniac with Chalk - Mild Spirit.

Cauſtic Spirit of Sal Ammoniac mixed with Acids, with Spirits of Wine, Lime Water, calcareous Nitre, &c.

Mild Spirit of Sal Ammoniac mixed with

Acids, with Spirits of Wine, Lime Water, calcareous Nitre, &c.

Eau de Luce made.

Degree of Cold, produced during the Solution of Sal Ammoniac in Water, obſerved by a Thermometer.

Equal quantities of Water of different Temperatures ſaturated with Sal Ammoniac, and the Degrees of Cold ſeverally produced during the Saturation, remarked.

Of the greateſt poſſible Degree of Cold which can be produced in Water by the Solution of Sal Ammoniac.

Of the Uſe of Sal Ammoniac in various Arts.

Of Borax.

Natural Hiſtory of Tincal or Crude Borax.

Borax vitrified.

Glaſs of Borax diſſolved in Water, and cryſtallized.

Sal Sedativus Hombergi ſeparated from

Borax by the Acids of Vitriol, Nitre, Sea Salt, and Vinegar, and procured by Sublimation and Cryſtallization.

The Reſidua examined, and the mineral fixt Alcali ſeparated therefrom.

Borax regenerated by combining together Sal Sedative and Mineral Alcali.

Sal Sedative diſſolved in Spirits of Wine, the green Colour of the Flame obſerved.

Of Copper ſuppoſed to be contained in Borax.

Account of the Attempts to make Artificial Borax in England.

Of the mechanic Uſes of Borax.

Of Mineral Earths, crude and calcined.

Diſtillation of Siliceous, Calcareous, Argillaceous, and Gypſeous Earths.

Account of the Experiments lately made at Paris by M. Darcet, and others, concerning the Infuſibility and Volatility of Diamonds in a great Degree of Heat.

Vitrification of a Mixture of Earths, ſeparately unvitrifiable in a given Degree of Heat.

Glaſs made from a Mixture of Alcaline Salts and powdered Flints.

Hiſtory of the Invention of Glaſs.

Of the Method of making and poliſhing plate Glaſs in France, &c.

Siliceous Earths rendered ſoluble in Water by means of Alcalies - Liquor Silicum.

Of European and Aſiatic Porcelane, and their ſpecific Difference.

Account of the Methods of making the white and yellow Staffordſhire Ware.

Calcareous Earths converted into Lime by Calcination.

Calcareous Earths converted into Lime by Solution and Precipitation.

Lime converted into calcareous Earth.

Dr. Black's Theory of Lime explained.

The Quantity of fixed Air contained in Alcalies, and calcareous Earths, and ſeparable by Solution, eſtimated by the Honourable Hen. Cavendiſh.

The loſs of Weight ſuſtained by calcareous Earths during Calcination eſtimated by Experiment, and ſhewn to correſpond with the quantity of fixed Air, ſeparated therefrom by Solution.

Of the Solubility of Lime in Water.

Of the Pellicle of Lime Water, and of the exceſs of its Weight above the Weight of the Lime diſſolved.

Is the ſmalleſt Quantity of Lime wholly ſoluble in the largeſt Quantity of Water, without undergoing a freſh Calcination?

Of Marle.

Of the Uſe of Lime, Marle, &c. in Agriculture.

Of Arſenic.

Natural Hiſtory of white Pyrites, Orpiment, Realgar, Cobalt Ores, and other mineral Subſtances affording Arſenic.

Method of procuring Arſenic in Saxony, called from its powdery Appearance, Farina Arſenicalis.

Farina Arſenicalis purified, and changed into white cryſtalline Arſenic, by being mixed with Pot-aſh and ſublimed.

Farina Arſenicalis mixed with the Sulphur of ſulphureous Pyrites, and changed into yellow or red cryſtalline Arſenic by Sublimation.

Arſenic diſſolved in Oil of Olives, in Oil of Turpentine, in a Solution of fixed Alcali, in rectified Spirits of Wine, in Aqua Fortis, in Acid of Sea Salt, in Aqua Regia, in Oil of Vitriol, in Vinegar, and in Water.

Arſenic and Nitre diſtilled together - Acid of Nitre - Reſiduum.

Macquer's neutral arſenical Salt extracted from the Reſiduum.

Nitre and Arſenic fuſed together in open Veſſels - Fume - Reſiduum called Nitre fixed by Arſenic.

Arſenic combined with Phlogiſton, and ſublimed into a metallic Appearance, commonly called Regulus of Arſenic.

Of METALLIC SUBSTANCES in general.

Of Mercury in a fluid State.

Natural Hiſtory of Mercury and of Cinnabar.

Mercury extracted from Earths or Stones with which it is mixed, by ſimple Lotion, and by Diſtillation without Addition.

Mercury extracted from Minerals, in which it is mineraliſed, by Diſtillation with Addition.

Method of aſſaying mercurial Minerals, and of diſcovering whether any particular Mineral contains Mercury.

Methods of purifying Mercury.

Mercury changed into a black Powder by long continued Trituration.

Mercury changed into a red Powder by

Calcination - Mercurius calcinatus - Mercurius præcipitatus per ſe.

Mercury boiled with Water.

Mercury revivified, from the Powders obtained by Trituration, and Calcination, by ſimple Diſtillation.

Account of Boerhaave's Experiments relative to the unchangeableneſs of Mercury, by the Proceſſes of Digeſtion, and Diſtillation.

Account of Profeſſor Braunius's Experiments, relative to the Converſion of Mercury into a ſolid malleable Metal, at Peterſburgh, by an artificial Cold reſulting from the Solution of Snow in the fuming Spirit of Nitre.

Of the Degree of Heat of boiling Mercury, and of the Limits within which Mercury may be uſed as a Thermometer.

Mercury triturated with Turpentine, with Lard, with Sugar, &c. - Mercurial Plaiſters, Ointments, Pills.

Mercury diſſolved in Acid of Nitre - The Solution diluted with diſtilled Water, Aqua mercurialis.

The Solution of Mercury in Acid of Nitre cryſtallized.

The ſame inſpiſſated - Calx Mercurii.

The inſpiſſated Maſs, or cryſtallized Salt, calcined to a red Colour - Mercurius præcipitatus ruber.

Mercurius præcipitatus ruber dulcified by Spirit of Wine - Mercurius corallinus - Arcanum corallinum.

Mercury precipitated from its Solution in Acid of Nitre by Copper.

Mercury corroded into a ſaline Maſs by Oil of Vitriol.

The preceding ſaline Maſs partly diſſolved, principally changed into an inſipid, indiſſoluble, yellow Powder, by frequent Ablution in warm Water - Mercurius emeticus flavus - Mercurii Præcipitatum flavum - Turpethum minerale.

Mercury precipitated, from the Waſhings of Turpeth mineral, by Alcalies.

Waſhings of Turpeth mineral inſpiſſated, and deliquiated - Oleum Mercurii.

Mercury united by Sublimation with the Acid of Sea Salt; Corroſive Sublimate made from a Mixture of unwaſhed Turpeth mineral and Sea Salt.

Corroſive Sublimate made from Cryſtals of Mercury in the nitrous Acid and Sea Salt.

Corroſive Sublimate made from crude Mercury, Nitre, calcined Vitriol, and Sea Salt.

Corroſive Sublimate rendered mild and inſipid, by Trituration with a ſufficient Quantity of crude Mercury and ſubſequent Sublimations - Mercurius dulcis ſublimatus - Calomelas - Aquila alba - Panacæa mercurialis - Draco mitigatus, &c.

Specific Gravities of corroſive Sublimate and Calomel, determined.

Corroſive Sublimate diſſolved in Water, and cryſtallized.

Corroſive Sublimate diſſolved in Spirits of Wine.

Mercury precipitated from a Solution of corroſive Sublimate in Water by fixed Alcalies - Mercurius præcipitatus fuſcus - by volatile Alcali - Mercurius præcipitatus dulcis - by Lime Water - Aqua Phagedenica.

Mercury precipitated from its Solution in Acid of Nitre by the Acid of Sea Salt, or by any neutral Salt containing the Acid of Sea Salt - Mercurius præcipitatus albus.

Mercury precipitated from its Solution in Acid of Nitre by the Acid of Vitriol, or any neutral Salt containing the Acid of Vitriol - Turpeth mineral.

Mercury diſſolved in the vegetable Acids, native, and fermented, and in fixed, and volatile Alcalies, after Marggraf's Method.

Account of M. le Comte de la Garaye's Tincture of Mercury in Spirits of Wine.

Mercury united with Sulphur by Trituration, and by Fuſion - Æthiops Mineral.

A Mixture of Sulphur and Mercury ſublimed - Factitious Cinnabar.

Factitious Cinnabar levigated - Vermillion.

Method of diſcovering whether Vermillion be adulterated with red Lead.

Mercury revivified by diſtilling Cinnabar with Iron-filings.

Mercury united with volatile Tincture of Sulphur, and with Hepar ſulphuris.

OF SEMIMETALS.

Of Antimony, and Regulus of Antimony.

Natural Hiſtory of Antimony, and other Ores of Regulus of Antimony.

Crude Antimony ſeparated from earthy and ſtony Impurities by Eliquation, or Diſtillation per Deſcenſum - Morſuli reſtaurantes Kunckelii.

Crude Antimony digeſted with Aqua regia, Solution of the metallic, and Separation of the ſulphureous Part effected thereby.

Crude Antimony calcined to an aſh-coloured Calx.

Calcined Antimony vitrified.

Glaſs of Antimony digeſted with Aqua regia, Sulphur ſometimes ſeparated thereby - Differences obſervable in the fuſibility, colour, pellucidity, and ſolubility of Glaſs of Antimony in Wines, and other Menſtruums, according to the different Degrees of Calcination uſed in preparing it.

Regulus of Antimony prepared, by fuſing the Calx, or Glaſs of Antimony with Charcoal, Soap, or other phlogiſtic Matters.

Regulus of Antimony prepared, by fuſing crude Antimony with Iron, with Lead, with Copper, &c.

Regulus of Antimony prepared, by fuſing crude Antimony with Tartar and Nitre.

Chief mechanic Uſes of Regulus of Antimony noticed.

Regulus of Antimony volatilized by a ſtrong Fire - Flowers of Regulus of Antimony.

Method of reducing Flowers of Regulus of Antimony.

Action of Acids upon Regulus of Antimony, examined.

Regulus of Antimony combined with the marine Acid by diſtilling Antimony and corroſive Sublimate together - Cauſticum Antimoniale, or Butter of Antimony.

Regulus of Antimony precipitated from the marine Acid, by diluting Butter of Antimony with Water - Pulvis Algaroth - Mercurius vitæ.

Regulus of Antimony precipitated from the Water uſed in the preceding Proceſs, commonly called Spiritus vitrioli philoſophicus by an Alcali.

Bezoard Mineral prepared, by repeated Abſtractions of the Acid of Nitre from Butter of Antimony - Spiritus Bezoardicus.

Antimony and Nitre mixed together in the Proportion of 2 to 1, and deflagrated - Crocus Antimonii mitior.

Antimony and Nitre mixed together in equal Parts, and deflagrated - Crocus Antimotimonii - Hepar Antimonii - edulcorated, Crocus metallorum.

Antimony and Nitre mixed together in the Proportion of 1 to 2, deflagrated and edulcorated - Emeticum mite Antimonii.

Antimony and Nitre mixed together in the Proportion of 1 to 3, deflagrated and edulcorated - Calx Antimonii - Antimonium diaphoreticum dulce.

Different chemical Properties of the preceding, and other ſimilar Combinations of Nitre and Antimony, explained; general Account of their medical Powers deduced therefrom.

Waſhings of Diaphoretic Antimony conſidered - Materia perlata, or Boerhaave's Sulphur fixatum ſtibii precipitated therefrom.

Regulus of Antimony reduced to a Calx, ſimilar to Diaphoretic Antimony, by Deflagration with Nitre, called Ceruſſe of Antimony.

Antimony combined with fixed Alcali by boiling them together - Kermes Mineral ſpontaneouſly precipitated from the Solution.

Tinctura Antimonii made by digeſting Hepar Antimonii in Spirits of Wine.

Vinum Antimoniale ſive Emeticum, made by digeſting Crocus Antimonii, or Glaſs of Antimony in Mountain Wine.

Tartarus emeticus made by boiling Glaſs, or Crocus of Antimony with Cream of Tartar.

Tartarus emeticus made, after Macquer's Manner, by combining Pulvis Algaroth and Cream of Tartar.

Of the medical Virtues of Antimonial preparations in general, and the Cauſe of the variable and uncertain Effects of particular Preparations explained.

Of Zaffre and Regulus of Cobalt.

Method of making Zaffre in Saxony.

The Zaffre of the Shops diſſolved in all the mineral Acids.

The Difference of the Colour of the Solution of Zaffre in weak and ſtrong Acid of Sea Salt obſerved.

The tawny Colour of Zaffre diſſolved in weak Spirit of Salt, changed into a green by heating the Solution.

Zaffre changed into a blue Glaſs by Vitrification, called Smalt.

Method of preparing from the blue Glaſs of Zaffre, an impalpable Powder, called in that State azure, enamel blue, Powder blue.

Of Lapis Lazuli, and the pigment called Ultramarine blue prepared therefrom, and its Difference from the azure prepared from Zaffre.

Regulus of Cobalt procured from Zaffre or Smalts, when melted in Conjunction with Matters containing Phlogiſton.

General Properties of Regulus of Cobalt enumerated.

Account of the manufacturing of Smalts in England.

Orpiment and Quicklime digeſted together with Water - Liquor vini probatorius.

Uſe of the preceding Liquor in detecting Adulterations of Wine by Saccharum Saturni, ſhewn from the different Colours of the Precipitates attending its Mixture with genuine and adulterated Wine.

Experiments with the aforeſaid Liquor as a ſympathetic Ink.

Of Nickel.

Nickel not ſoluble in Acid of Vitriol, with difficulty in Acid of Sea Salt, readily by Acid of Nitre into a green Colour.

Nickel precipitated from Acid of Nitre by a fixed Alcali into a greeniſh Powder.

Nickel compared with Regulus of Cobalt.

Experiments with ſympathetic Inks from Solutions of Nickel and Cobalt.

Of Biſmuth.

Natural Hiſtory of Biſmuth.

Biſmuth ſublimed into yellowiſh Flowers by a ſtrong Fire.

Biſmuth changed into an aſh-coloured Powder by Calcination.

Calx of Biſmuth vitrified.

Vitrified Calx of Biſmuth reduced by the Addition of Phlogiſton.

Biſmuth diſſolved in Acid of Nitre.

Solution of Biſmuth in Acid of Nitre cryſtallized.

Biſmuth precipitated from its Solution in Acid of Nitre by the Affuſion of Water, - Magiſtery of Biſmuth, - Blanc de fard.

Biſmuth precipitated from the Waſhings of the Magiſtery by a fixed Alcali.

Biſmuth and Mercury melted together - Amalgam.

Biſmuth, Lead, and Mercury, melted together - Method of falſifying Quickſilver - Method of detecting the Adulteration of Quickſilver.

Biſmuth not miſcible by Fuſion with Nickel.

Of Zinc.

Natural Hiſtory of Lapis Calaminaris, Black Jack, and other Ores of Zinc.

Zinc procured by diſtilling Lapis Calaminaris with Charcoal.

Account of the Method of making Engliſh Zinc at the Copper Works near Briſtol, and its difference from Indian Zinc ſhewn.

Zinc calcined in a gentle Fire, inflamed in a ſtrong Fire - Flowers of Zinc, or Lana Philoſophorum ſeparated during the Combuſtion of Zinc.

Flowers of Zinc vitrified.

Flowers of Zinc reduced in cloſe Veſſels.

Flowers of Zinc diſſolved in all the Acids.

Zinc deflagrated with Nitre.

Zinc diſſolved in Acid of Vitriol - Nature of the black Flocculi ſeparated during the Solution.

Solution of Zinc in Acid of Vitriol cryſtallized - white Vitriol.

Method of diſcovering whether white Vitriol contains Copper.

Difference between Engliſh and Goſlarian white Vitriol.

Zinc diſſolved in Acid of Nitre.

Solution of Zinc in Acid of Nitre cryſtallized.

Zinc diſſolved in the concentrated Acid of Sea Salt, and in the aqueous Acid of Vitriol - Inflammable Air ſeparated during the Solution in each Menſtruum.

The Quantity, and ſpecific Gravity of the inflammable Air ſeparated from Zinc by Solution, eſtimated by the Hon. Henry Cavendiſh.

Zinc not acted upon by Sulphur, or Liver of Sulphur - Purified thereby from all other metallic Subſtances.

Zinc not miſcible by Fuſion with Biſmuth.

OF METALS.

Of Lead.

Natural Hiſtory of Lead Ores.

Account of the two different Methods of extracting Lead from its Ore, as practiſed in Derbyſhire.

Lead extracted from its Ore - Method of aſſaying ſimple Lead Ores.

Lead in Fuſion partly volatilized, chiefly converted into a gray Calx, called Plumbum uſtum, or calcined Lead.

Plumbum uſtum melted in a ſtrong Fire - Litharge.

Account of the Method of making red Lead from Plumbum uſtum, as practiſed in Derbyſhire.

Account of the Method of making red Lead from Litharge, as practiſed in Flintſhire.

Remarks concerning the quantity, and cauſe of the Increaſe of Weight, gained by the Converſion of Lead into Minium.

Glaſſes of Lead made from Minium ſimple, and mixed with vitrifiable Earth in different Proportions.

Artificial Ores, perfectly reſembling ſome kinds of natural Ores of Lead, made from an Union of Lead and Sulphur.

Of black Lead or Wadd.

Method of diſtinguiſhing the factitious from the true black Lead.

Black Lead expoſed to a ſtrong Fire in cloſe Veſſels - Fixity remarked.

Black Lead expoſed to a ſtrong Fire in open Veſſels - Loſs of Weight remarked.

Calcined black Lead attracted by the Magnet.

Lead corroded into a white Calx by the Vapour of Vinegar, called Ceruſſe or white Lead.

Account of the Method of Manufacturing white Lead at Holywell, and other

Places, and of the increaſe of Weight gained by the Lead.

White Lead, Minium, or Litharge, diſſolved in diſtilled Vinegar, and cryſtallized - Sugar of Lead.

Crude Lead, white Lead, Minium, or Litharge diſſolved in Oil of Olives - Common Diachylon Plaſter.

Method of diſcovering whether Oil of Olives be adulterated, by means of Lead, with Rapeſeed, or other expreſſed Oils.

Lead ſeparated, from its Solution in Oils, by Vinegar.

Lead diſſolved in Acid of Nitre, and cryſtallized.

Lead precipitated from Acid of Nitre by Acid of Vitriol, or any neutral Salt containing Acid of Vitriol; by Acid of Sea Salt, or any neutral Salt containing Acid of Sea Salt.

Lead diſtilled to Dryneſs with Oil of Vitriol - Sulphureous Acid - Sulphur - Saline Reſiduum.

Sulphur procured inſtantaneouſly by

pouring Oil of Vitriol upon Lead in Fuſion, and collecting the Vapour.

Lead or Minium diſtilled with Sal Ammoniac - Volatile Alcaline Spirit - Volatile Alcaline Salt - Reſiduum, or a Combination of the Acid of Sea Salt with Lead, called Plumbum corneum.

Plumbum corneum fuſed.

Plumbum corneum diſſolved in Water, and cryſtallized.

Lead and Mercury melted together in different Proportions - Amalgams of various Conſiſtencies.

Of Copper.

Natural Hiſtory of Copper.

Account of the Proceſſes uſed in extracting Copper from its Ore, at Ecton, Macclesfield, Cheadle, &c.

Regulus and Scoria of the firſt, ſecond, third, and fourth Fuſion of Copper Ore examined, and the Reaſon of their Differences explained.

Copper combined with Sulphur by Stratification and Cementation - Æs uſtum.

Copper combined with Sulphur by Fuſion - Artificial Ore of Copper.

Copper combined with Arſenic by Fuſion - white Copper.

Of Chineſe white Copper, improperly called Tutenag, and its Difference from the preceding white Copper ſhewn.

Copper changed into Braſs, by cementing and fuſing Copper in conjunction with calcined Calamine and Charcoal.

Copper changed into Braſs, by ſubſtituting, in the preceding Proceſs, calcined black Jack for Calamine.

Braſs changed into Copper, by diſſipating the Zinc or metallic Part of the Calamine, in a ſtrong Fire.

The Increaſe of Weight, gained by the Copper in being changed into Braſs, eſtimated.

Copper melted with Zinc - Pinchbeck.

Difference betwen Pinchbeck and Braſs obſerved, and the Reaſon explained.

Copper melted with Tin in various Proportions - Bell metal - Bronze, &c.

Equal Parts of Copper and Tin melted together, their mutual Penetration and Increaſe of ſpecific Gravity obſerved.

Copper diſſolved in Oil of Vitriol.

Solution of Copper in Oil of Vitriol cryſtallized - Blue Vitriol.

Copper precipitated from a Solution of blue Vitriol by Iron - Cuprum præcipitatum, called Ziment Copper.

Account of the Cement or Ziment Waters at Newſol in Hungary, Arklow in Ireland, in Angleſea, &c. and of the Methods of procuring Copper from them.

Copper diſſolved in Acid of Nitre, and cryſtallized.

Copper precipitated from Acid of Nitre by Chalk - Verditer Blue.

Copper diſſolved in Acid of Sea Salt, and cryſtallized.

Cryſtals of Copper, in the Acids of Sea Salt, and Nitre, when diſſolved in Spirits of

Wine, communicate a green Colour to the Flame.

Copper diſſolved in Oils, in vegetable Acids, in fixed, and volatile Alcalies, in neutral Salts, &c.

Account of the Method of making Verdigriſe at Montpellier, and in England.

Various mechanical Applications of Verdigriſe enumerated.

Verdigriſe diſſolved, in Part, in diſtilled Vinegar.

Solution of Verdigriſe in diſtilled Vinegar cryſtallized, improperly called Viride Æris diſtillatum.

Cryſtals of Verdigriſe diſtilled - Concentrated Acid of Vinegar, called Acetum Radicatum - Cupreous Reſiduum.

Acetum Radicatum mixed with rectified Spirits of Wine, and acetous Æther made after the Manner of M. le Comte de Lauragais.

Of Iron.

Natural Hiſtory of Iron.

Account of the Proceſſes uſed in extracting Iron from its Ores in different Parts of England and Wales; and of the Attempts to make Pig Iron by Coke and charred Peat.

Method of converting Pig Iron into Bar Iron.

Of the Tenacity of Iron Wire.

Iron converted into Steel.

Steel converted into Iron.

Steel hardened, and rendered brittle and elaſtic.

Of Tempering of Steel.

Iron deprived of its Phlogiſton by various Ways - Different kinds of Crocus Martis.

Natural Hiſtory of Ochres.

Red and yellow Ochres converted into Iron by the Addition of Phlogiſton.

Iron deprived of its Phlogiſton by Deflagration with Nitre.

Iron combined with Sulphur.

Iron diſſolved in Acid of Vitriol - Sal Martis.

Iron diſſolved in Acid of Sea Salt.

The inflammable Air ariſing from Iron during the two preceding Solutions collected and inflamed.

Of fulminating Damps in Mines.

Method of freeing the Coal-pits at Whitehaven from inflammable Air deſcribed.

Iron diſſolved in Acid of Nitre, elaſtic but not an inflammable Air produced thereby.

Hiſtory of the Diſcovery of the Method of making Pruſſian Blue.

Pruſſian Blue made by precipitating a Solution of green Vitriol with an Alcali ſaturated with Phlogiſton.

The colouring Matter of Pruſſian Blue extracted by an Alcali.

Iron precipitated from any of its acid Solvents into a blue Powder by a fixed Alcali, ſaturated with the colouring Matter of Pruſſian Blue.

Iron precipitated from any of its acid Solvents into a black Powder by a Decoction of Galls or other aſtringent Vegetables.

Nature of Ink and of the black Dye, and the Difference between them explained.

Beccher's Experimentum ferriferum conſidered.

Iron ſhewn to exiſt in common Sand, in coloured Clays, in the Aſhes of Vegetables, in the Aſhes obtained from the Blood, Urine, and Fleſh of Animals.

Vegetable Aſhes melted into a green or blue Glaſs, according to the Violence of the Fire.

Iron filings or Colcothar of Vitriol mixed with Sal Ammoniac and ſublimed - Flores Martiales - Reſiduum.

Reſiduum deliquiated - Lixivium Martis - Oleum Ferri.

Flowers of iron digeſted with Spirits of Wine - Tinctura Florum martialium.

Iron precipitated from its Solution in Acid of Nitre by fixed Alcali - Sthal's alcaline Tincture of Iron.

Iron combined with Cream of Tartar by grinding them together - Rotuli Martiales - Mars ſolubilis; by boiling, Tartarus Chalybeatus, Tinctura Styptica Helvetii.

Iron diſſolved in Rheniſh Wine - Vinum Chalybeatum.

Of Tin.

Natural Hiſtory of Tin.

Of the Proceſſes of ſtamping, buddling, and trunking uſed in Cornwall for preparing Tin Ore for Fuſion.

Of the Magnetiren uſed in ſome Parts of Germany.

Tin melted and granulated.

Tin rendered hard and ſonorous by being melted in Conjunction with Regulus of Antimony, with Zinc, with Biſmuth,&c.

Of Pewter and its different Kinds.

Of different metallic Mixtures which melting with leſs Heat than the Metals to which they are applied, conſtitute Solders of various Kinds.

Method of manufacturing Tin Plates in England and Germany, and of tinning Copper Veſſels.

Tin calcined ſingly and in Conjunction with Lead - Putty.

Calces of Lead and Tin melted with calcined Flints, or other vitrifiable Earths, and alcaline Salts, in various Proportions - white Enamels.

White Enamels converted into different Colours, by the Addition of metallic Calces, and applied upon Engliſh and Indian Porcelain.

Paſtes and artificial precious Stones made, and their Difference from coloured Enamels explained.

Tin amalgamated with Quickſilver, and the Amalgam mixed with Sulphur and Sal Ammoniac, and ſublimed - Reſiduum called Aurum moſaicum or muſicum.

Tin diſſolved in Aqua regia - Different Conſiſtences of the Solutions.

Tin diſſolved in Acid of Nitre.

Uſe of the preceding Solutions of Tin in precipitating the colouring Matter of Cochineal.

Woollen and Linen boiled in Cochineal precipitated by Tin - Reaſon of the different Dyes explained by Macquer.

Inflammable Air ſeparated from Tin during its Solution in Acid of Vitriol and Acid of Sea Salt.

Account of Marggraf's Experiments upon the Solubility of Tin in vegetable Acids native, and fermented.

Tin amalgamated with Quickſilver, and the Amalgam diſtilled with corroſive Sublimate - Liquor fumans Libavii - Butter of Tin - Revivified Mercury.

Looking Glaſs ſilvered by amalgamating Mercury and Tin.

Tin, Biſmuth, and Lead melted together, and mixed with Mercury - Method of ſilvering concave Glaſs Veſſels with the Mixture.

Of Silver.

Natural Hiſtory of Silver.

Account of the Method of ſeparating native Silver from the Stones or Earths in which it is imbedded, by Amalgamation with Mercury; as practiſed at Potoſi and other Spaniſh Silver Mines in America, and at Kungſburg in Norway.

Account of the Method of ſeparating Silver when mineraliſed with ſulphurated Lead, as practiſed in Flintſhire, and in Northumberland.

Cardiganſhire lead Ores aſſayed for Silver.

Silver purified from Semimetals, and imperfect Metals, by Cupellation with Lead.

Silver purified from ſuch minute Portions of Copper as eſcape Cupellation, by Fuſion with Nitre and Borax.

Silver ſeparated from $\frac{1}{3}$, or any leſs Part of its Weight of Gold by Solution in Acid of Nitre - Quartation or Departure.

Silver recovered from its Solution in Acid of Nitre by precipitation with Copper.

Solution of Silver in Acid of Nitre cryſtallized.

Cryſtals of Silver melted - Lunar Cauſtic.

Silver precipitated from Acid of Nitre, by Acid of Vitriol, or by any neutral Salt containing Acid of Vitriol.

Silver diſtilled to Dryneſs with Acid of Vitriol - Sulphureous Acid - Saline Reſiduum.

Saline Reſiduum diſſolved in Water, and cryſtallized.

Silver precipitated from Acid of Nitre, by Acid of Sea Salt, or by any neutral Salt containing it - Luna Cornea.

Marggraf's Method of obtaining Silver abſolutely pure by the Reduction of Luna Cornea.

Silver precipitated from its Solution in Acid of Nitre by fixed Alcali.

Precipitated Silver diſſolved in vegetable Acids, in volatile, and phlogiſticated fixed Alcalies, according to Marggraf's Method.

Pure Silver made harder by being melted with Copper in the Proportion of 37 to 3 - Standard Silver of England.

Silver precipitated from Acid of Nitre, largely diluted with Water, by means of Mercury - Arbor Dianæ.

Silver combined with Sulphur into an artificial Ore reſembling the Minera Argenti vitrea.

Of Gold.

Natural Hiſtory of Gold.

Method of ſeparating native Gold from Sands, Earths, &c. by Amalgamation with Quickſilver.

Method of extracting Gold when mineralized, or when ſo mixed with Sulphur by means of other Metals as to eſcape the Action of Quickſilver and Aqua regia.

Gold ſoluble in Aqua regia, but not in Acid of Nitre.

Silver ſoluble in Acid of Nitre, but not in Aqua regia.

Method of purifying Gold from all metallic Subſtances by Solution in Aqua regia, and Precipitation with green Vitriol.

Method of ſeparating a minute Portion of Gold from a large Quantity of Silver, by melting the Mixture with Sulphur, as practiſed at Rammelſberg.

Gold precipitated from its Solution in Aqua regia made with Acid of Nitre and Acid of Sea Salt, by volatile Alcali - Aurum fulminans.

Aurum fulminans deprived of its fulminative Power by Oil of Vitriol, by Fuſion with Sulphur, by fixed Alcali, and in part by Ablution with Water.

Gold precipitated from its Solution in

Aqua regia, when largely diluted with Water, by Plates of Tin, or by a Solution of Tin in the ſame Menſtruum - Purple Magiſtery of Caſſius.

Glaſs changed into an artificial Ruby by being melted with Caſſius' purple Magiſtery.

Gold extracted from its Solution in Aqua regia, and kept ſuſpended in Æther.

Method of ſeparating Gold from gilt Copper.

Gold precipitated from its Solution in Aqua regia by fixed Alcali.

Precipitated Gold diſſolved by the ſame Menſtruums as precipitated Silver.

Gold diſtilled to Dryneſs with the Acid of Vitriol, with the Acid of Sea Salt, and with the Acid of Nitre - Inſoluble in theſe Menſtruums.

Gold diſſolved in Hepar Sulphuris.

Pure Gold hardened by being melted with Copper, or with an Admixture of Copper and Silver, in the Proportion of 22 to 2 - Standard Gold of England.

Gold amalgamated with Mercury – Methods of gilding and ſeparating Gold from gilt Works.

Of MINERAL WATERS in general, and their various Impregnations.

Different Methods of aſſaying mineral Waters, and their Imperfections.

Of Thermæ or hot mineral Waters, and the different Conjectures concerning the Cauſe of their Heat.

Accounts of Dr. Brownrigg's Experiments on the fixed Air contained in Spa Water.

M. Lane's Experiments concerning the Suſpenſion of Iron in Water, by means of fixed Air diſcharged either from fermenting, or effervefcing Mixtures.

Of Bituminous Subſtances.

Natural Hiſtory of Bituminous Subſtances.

Newcaſtle Coal diſtilled - Phlegm - Acid - Air - Oil - Caput mortuum.

Air diſcharged from Newcaſtle Coal by Diſtillation, collected, and ſhewn to be inflammable, and to retain its elaſticity and inflammability for ſeveral Days.

Peat from the Iſle of Ely diſtilled - Phlegm - Acid - Oil - Alcali - Caput mortuum.

Amber diſſolved in Spirits of Wine.

Amber precipitated from its Solution in Spirits of Wine by Water.

Amber diſtilled - Phelgm - Acid Spirit - Volatile acid Salt - Oil - Caput mortuum.

Method of rectifying Oil of Amber.

Method of purifying Salt of Amber.

Amber Varniſh made by different Methods.

OF VEGETABLES.

Of vegetable Juices ſpontaneouſly extravaſated, or exuding upon Inciſion.

Of liquid Reſins, or Balſams.

Venice Turpentine diſtilled without Addition with the Heat of boiling Water - Acidulated Phlegm - Colourleſs eſſential Oil, commonly called Æthereal Spirit of Turpentine - Reſinous Reſiduum.

The Reſiduum of the preceding Proceſs diſtilled with a Degree of Heat exceeding that of boiling Water - Acid - Yellow Oil - Reſiduum called Colophony.

Colophony diſtilled to Dryneſs - Acid - Reddiſh Oil, called by ſome, Balſam of Turpentine - Caput mortuum.

Common Turpentine diſtilled with Water - Eſſential Oil, vulgarly called Spirit of

Turpentine - Reſiduum - Terebinthina cocta or common Roſin.

Turpentine diſſolved in Spirits of Wine, and precipitated therefrom by Water.

Of Tar and Pitch, and the Method of procuring them.

Tar diſſolved in Part in Water.

Of Lamp Black, and the Method of obtaining it.

Balſam of Capivi diſtilled Balneo Arenæ - Acid - Yellow Oil - Blue or green Oil - Caput mortuum.

Of Balſam of Gilead, Balſam of Peru, Balſam of Tolu, liquid Amber, &c.

Of ſolid Reſins.

Benzoine diſſolved in Spirits of Wine, and precipitated therefrom by Water - Virgins Milk.

Acid Phlegm and eſſential Salt, commonly called Flowers of Benzoine, obtained from Benzoine by Sublimation.

Eſſential Salt obtained from Benzoine by Elixation with Water and Cryſtallization.

Flowers of Benzoine diſſolved in Water, and in Spirits of Wine.

The Reſiduum from the Sublimation of the Flowers of Benzoine diſtilled - Acid - Oil of different Conſiſtences - Caput mortuum.

Elemi - Maſtic - Copal - Dragon's Blood, and other ſolid Reſins diſſolved in Spirits of Wine and Oils.

Different Kinds of Varniſhes made, and applied upon Wood and Metals.

Of Camphor.

Native Camphor.

Rough Camphor refined by Sublimation.

Rough Camphor refined by Solution in Spirits of Wine.

Camphorated Spirits of Wine inflamed.

Camphor diſſolved in Acid of Nitre, and in Acid of Vitriol.

Camphor ſeparated from Spirits of Wine, and from mineral Acids by the Addition of Water.

Of Gums.

Gum Arabic, Gum Tragacanth, Gums from Pear Trees, Plumb Trees, Apricot Trees, &c. diſſolved in Water - Mucilages.

Gums diſſolved in Water, and precipitated therefrom by Spirits of Wine.

Gums diſtinguiſhed from Reſins principally by their Solubility in Water, and Inſolubility in Spirits of Wine, and by their being neither fuſible, nor inflammable in Fire.

Gum Arabic diſtilled - Acid - Oil - Volatile Alcali - Caput mortuum.

Of Gummy Reſins.

Gum Ammoniac diſſolved in Spirits of Wine.

Gum Ammoniac diſſolved in Water.

Of Aſſa fœtida, Myrrh, Frankincenſe, and other gummy Reſins.

Of VEGETABLE JUICES obtained by Trituration, and Expreſſion.

Of eſſential Salts of Plants.

Native aqueous Juices expreſſed and clarified.

Native aqueous Juices evaporated and cryſtallized - Eſſential Salts.

Of neutral Salts contained in Vegetables.

Hiſtory of Sugar, and of the Method of preparing it.

Brown or gray Muſcovade - Melaſſes, or Treacle.

Method of refining Sugar.

Sugar diſſolved in Water and cryſtallized - Saccharum candum, et cryſtallinum.

Sugar diſſolved in rectified Spirits of Wine, and cryſtallized.

Refined Sugar diſtilled - Acid - Oil - Air - Caput mortuum.

Of ſaccharine Juices obtainable from Maple Trees, Birch Trees, Sycamore Trees, &c. by tapping; from Fruits and Roots of various Kinds, by Solution in Spirits of Wine; from the ſpontaneons Exudations of the Fraxinus rotundiore Folio, and other Trees producing Manna; and from various Flowers affording Honey to the Bee.

Native Juices of Vegetables inſpiſſated to different Conſiſtences - Liquid or ſolid Extracts by Expreſſion.

Of Aloes, Opium, Acacia vera, and other ſolid Extracts by Expreſſion.

Of expreſſed Oils.

Oils obtained by Expreſſion from Linſeed, Muſtard Seed, ripe Olives, Almonds, Walnuts, &c.

Expreſſed Oils diſtinguiſhed principally from eſſential Oils, in not being ſoluble in Spirits of Wine, nor volatile in the heat of boiling Water, and in having ſcarce either taſte or ſmell.

Method of impregnating expreſſed Oils with the odorous Principle of Violets, Lilies, Roſes, &c. - Various Perfumes.

Oil of Olives diſtilled - Phlegmatic Acid - Oil - fixed Oil - Caput mortuum.

Of the Rancidity of expreſſed Oils.

Expreſſed Oils ſuſpended in Water by means of Mucilages - Emulſions - Milky Juices of Plants.

Of the Combination of Oils with fixed Alcali.

Fixed Alcali deprived of its fixed Air by Quicklime - Cauſtic Alcali - Soap Leys.

Soap Leys inſpiſſated - Cauterium potentiale, lapis infernalis.

Oil of Olives, Oil of Turpentine, Train Oil, - Tallow, &c. diſſolved in Soap Leys - Soaps of various Kinds.

Solution of Soap in diſtilled Water, and in Spirits of Wine.

Solution of Soap in Water decompounded by Acids, and by earthy, or metallic neutral Salts.

Method of analyzing Vegetables further explained, by Infuſion, and Decoction in various Menſtruums.

Carduus Benedictus infuſed in cold Water.

Carduus Benedictus boiled in Water.

Peruvian Bark infuſed in cold Water.

Peruvian Bark boiled in Water.

Jalap digeſted with Spirits of Wine - Tincture of Jalap - Reſiduum.

The Reſiduum of the preceding Proceſs boiled with Water and inſpiſſated - Aqueous Extract of Jalap.

Reſin of Jalap precipitated from Tincture of Jalap by Water.

Method of obtaining the reſinous and gummy Parts of Vegetables, and of making ſpirituous, aqueous, and mixt Extracts.

Aqueous Decoction of red Saunders.

Spirituous Decoction of red Saunders.

Aqueous Decoction of Brazil Wood.

Spirituous Decoction of Brazil Wood.

Aqueous Decoction of Alkanet Root.

Spirituous Decoction of Alkanet Root.

Red Saunders digeſted in Oil of Turpentine.

Alkanet Root digeſted in Oil of Turpentine.

Archel boiled in Water, in Oils, in Acids, in Spirits of Wine, in fixed Alcalies, and in volatile Alcalies.

The colouring Matter of ſome Vegetables

precipitated by Alum, Solutions of Tin, &c. - Lakes.

Various Experiments relative to the production, change, and recovery of Colours, by different ſaline Additions to coloured vegetable Infuſions.

Of Dying in general.

Method of analyzing Vegetables by Diſtillation, exemplified in various Inſtances, and various Degrees of Heat.

Mint, Thyme, Roſemary, Lavender, or other aromatic Plants diſtilled with a Heat leſs than that of boiling Water and without Addition - Spiritus rector, or odorous Principle.

The ſame Plants diſtilled with the Addition of Water, and with the heat of boiling

Water - Eſſential Oils - Aromatic or ſimple diſtilled Waters.

Of the different weights, colours, and conſiſtences, of eſſential Oils.

Eſſential Oils by Expreſſion from Oranges, Citrons, &c.

Method of obtaining them in Italy.

Eſſential Oils ſoluble in Spirits of Wine.

Roſemary Tops, Lavender Flowers, &c. diſtilled with Spirits of Wine - Spirit of Roſemary, Spirit of Lavender, &c. more commonly called Hungary Water, Lavender Water, &c.

Eſſential Oil of Roſemary, and of Lavender, precipitated from Hungary Water and Lavender Water, by the Affuſion of Water.

Of diſtilled ſpirituous Waters.

Roſemary, &c. after the Extraction of their eſſential Oil, diſtilled to Dryneſs - Phlegm - Acid - Empyreumatic Oil - Caput mortuum.

Method of making Charcoal explained.

Charcoal not acted upon by Water, Acids, Alcalies, vinous Spirits, or Oils.

Charcoal decompoſed by burning - Phlogiſton - Reſiduum.

Quantity of Reſiduum from a given Weight of Charcoal eſtimated.

Fixed alcaline Salt and Earth obtained from the Reſiduum.

Of the Method of manufacturing and depurating Pot-aſh.

Of the difference between the mineral fixed Alcali, or Natron of the Antients, and the vegetable fixed Alcali.

Analyſis of Woods.

Oak diſtilled B. M. - Phlegm - Reſiduum.

Reſiduum diſtilled - Phlegm - Acid - Air - Oil lighter and heavier than the Acid - Caput mortuum.

Air from Oak not deſtructive of Flame, but inflammable after paſſing through Water,

ter, and through fixed alcaline Lixivia, and retaining its inflammability for ſeveral Days.

Of the different quantities of Charcoal, of liquid Contents, and of fixed Air obtained from equal Weights of Oak, Box, Hazel, Willow, and other Woods by Diſtillation.

Of the beſt kinds of Charcoal requiſite for the making of Gunpowder, fluxing of Metals, &c.

Volatile Alcali diſengaged from the Acid of Oak by fixed Alcali.

Acid of Box-wood rectified.

Rectified Acid of Box ſaturated with vegetable and mineral fixed Alcalies - Nature of neutral Salts from the diſtilled Acids of Vegetables.

Analyſis of the Tetradynamia of Linnæus.

Muſtard Seed, Pepper Wort, &c. diſtilled with the heat of boiling Water - Phlegm ſapid and odorous, but neither manifeſtly acid nor alcaline.

Muſtard Seed, &c. diſtilled with a degree of Heat ſuperior to that of boiling Water - Volatile Alcali, Acid, Air, Oil, Caput mortuum.

Of Soot.

Wood Soot diſtilled - Acid - Volatile Alcali - Empyreumatic Oil - Sal Ammoniac - Caput mortuum, yielding fixed Alcali.

Of Wax.

Wax diſtilled - Acid - Oil - Congealed Oil - Caput mortuum.

Congealed Oil or Butter of Wax rectified - Acid - Yellow Oil - Fat brown Reſiduum.

Methods of bleaching yellow Wax, and of colouring bleached Wax.

OF FERMENTATION in general.

Of the vinous Fermentation.

Hiſtory and Uſe of Malting as preparatory to the Fermentation of farinaceous Seeds.

Equal Weights of Barley, Rye, Wheat, Oats, Beans, Peaſe, converted into Malt, and after Decoction for the ſame time in equal Quantities of Water expoſed to Fermentation - Ale of different Sorts.

The medium heat of fermenting Wort eſtimated by the Thermometer, and ſhewn to be equal to the medium heat of an Animal Body.

The Air generated during the vinous Fermentation ſhewn to be deleterious to Animal Life and to Flame.

The ſpecific gravity of Air generated by vinous Fermentation proved by the Hon. Henry Cavendiſh to be greater than that of common Air, and to be equal to that ſeparable from Marble by Solution, or about 511 Times lighter than Water, when common Air is ſuppoſed 800 Times lighter.

Equal Weights of Raiſins, refined Sugar, brown Sugar, Treacle mixed with equal Quantities of Water and fermented - Wines of different Kinds.

Ale diſtilled - Malt Spirits - Reſiduum.

Wine diſtilled - Brandy - Reſiduum.

Potatoes fermented and diſtilled - Potatoe Brandy.

Of the Methods of making Malt Spirits, Brandies, Rums, Arracks, and the Origin of their different Odours and Flavours explained.

Malt Spirits, Brandy, &c. diſtilled - Alcohol, or rectified Spirits of Wine - Acidulated Phlegm.

Of the Identity of Alcohol from whatever fermented Liquor it is diſtilled.

Of proof Spirit.

Uſual Methods of eſtimating the Strength of Brandies, Rums, &c. and their Imperfections.

Alcohol and Water mixed together, the Bulk of the Mixture ſhewn to be conſiderably leſs than the Sum of the ſeparate Bulks.

Method of judging accurately concerning the Strength of ſpirituous Liquors pointed out.

Of the Arrack or Coſmos prepared by the Calmuck Tartars from Mares Milk.

Method of obtaining white and red Tartar.

Tartar purified - Cream or Cryſtals of Tartar.

Tartar diſtilled - Acid - Air - Oil - Volatile Alcali - Caput mortuum.

Fixed alcaline Salt extracted from the Caput mortuum of diſtilled Tartar without burning it.

Cryſtals of Tartar combined with abſorbent Earths.

Cryſtals of Tartar combined with the fixed Alcali of Tartar - Sal vegetabilis, Tartarus tartariſatus.

Cryſtals of Tartar combined with the fixed Alcali - Sal Polychreſtus de Saignette - Rochelle Salt.

Cryſtals of Tartar combined with volatile Alcali.

Of the acetous Fermentation, or the ſpontaneous Converſion of Ales and Wines into Alegars and Vinegars.

Method of making Vinegars, and of diſcovering whether they are adulterated with Oil of Vitriol.

Vinegar diſtilled - Phlegm - Acid - Extract.

Method of diſcovering whether Vinegar be depraved by Lead.

Extract of Vinegar diſtilled - Acid - Empyreumatic Oil - Volatile alcaline Salt, and Spirit - Caput mortuum.

Vinegar concentrated by freezing the phlegmatic Part.

Diſtilled Vinegar combined with abſorbent Earth.

Diſtilled Vinegar combined with the fixed Alcali of Tartar - Sal Diureticus - Terra foliata Tartari.

Diſtilled Vinegar combined with the mineral fixed Alcali, and cryſtallized.

Diſtilled Vinegar combined with volatile Alcali - Spiritus Mindereri - Acetous Sal Ammoniac.

Combinations of the Acid of Tartar with the vegetable and fixed Alcalies, decompoſed by the Acid of Vinegar.

Difference between the Acid of Tartar, and that of Vinegar.

Of the putrefactive Fermentation of Vegetables.

OF ANIMALS.

General Analyſis of animal Fluids exemplified in the Analyſis of Milk, Blood, Urine, and Whites of Eggs.

Of Milk.

Cows Milk diſtilled Balneo Mariæ - Phlegm tranſparent, colourleſs, inſipid - Unctuous ſaline Reſiduum.

Aſſes Milk diſtilled Balneo Mariæ - Phlegm - Reſiduum.

Proportion of Phlegm ſeparable from equal Weights of Cows Milk and Aſſes Milk by Diſtillation B. M. aſcertained.

Equal Weights of Cows Milk, Goats Milk, Woman's Milk, Aſſes Milk evaporated to Dryneſs - Proportion of the Reſiduums, and of the ſaline and earthy Matter contained in them.

Reſiduum from the Diſtillation of Milk B. M. diſtilled - Acid - Empyreumatic Oil - Volatile Alcali - Caput mortuum, containing fixed Alcali.

Milk ſpontaneouſly ſeparated into Cream and Skim-Milk.

Cream reſolved into Butter - Curd - Whey.

Skim-Milk reſolved into Whey - Curd - Butter.

Butter diſtilled - Acid - Oil - Caput mortuum.

Curd diſtilled - Alcali volatile in a fluid and concrete Form - Fetid Oil - Caput mortuum.

Whey evaporated and cryſtallized - Sugar of Milk - Sea Salt.

Milk not coagulable by the Heat of boiling Water.

Milk coagulable by Acids, by Alcalies, by vinous Spirits, by ſome neutral Salts earthy and metallic.

Of Blood.

Blood examined by a Microſcope - Tranſparent Fluid - Red Globules of various Sizes.

Blood warm from the Vein diſtilled Balneo Mariæ - colourleſs, inſipid Phlegm - Reſiduum.

Of the Quantity of Phlegm contained in the Blood of different Animals, and ſeparable therefrom by the Heat of boiling Water.

Phlegm, impregnated with volatile Alcali, obtained from Blood by the Heat of a boiling fixed alcaline Lixivium.

Blood exſiccated by the Heat of the Sun.

Blood exſiccated by the Heat of the Sun, or by Diſtillation B. M. not ſubject to Putrefaction.

Exſiccated Blood diſtilled - Volatile alcaline Spirit and Salt - Air - Empyreumatic Oil - Caput mortuum.

Blood ſpontaneouſly reſolved, by Expoſure to the Air, into a fluid and coagulated Part - Serum - Craſſamentum.

Account of Mr. Hewſon's Experiments, relative to the Cauſe of the ſpontaneous Coagulation of Blood when taken out of an animal Body.

Blood prevented from ſpontaneous Coagulation by Sea Salt, and other neutral Salts.

The Craſſamentum reſolved, by Ablution, into a white fibrous Part, called by ſome the coagulable Lymph, not ſoluble in Water, and a red colouring Part, called the red Globules, reckoned ſoluble in Water.

The fibrous Part or coagulable Lymph diſtilled.

The red globular Part diſtilled.

The Serum coagulated by boiling Water, by Acids, and by vinous Spirits.

Of Urine.

Freſh Urine gives no Marks of containing either acid or alcaline Salts.

Freſh Human Urine diſtilled B. M. - Colourleſs Phlegm with an urinous Smell - Reſiduum.

Reſiduum diſtilled - Volatile Alcali in a fluid and concrete Form - Oil - Sal Ammoniac - Caput mortuum, yielding Sea Salt by Elixation, and fixed Alcali by Calcination.

Horſes Urine diſtilled - Phlegm - Volatile alcaline Spirit - Oil - Caput mortuum, yielding fixed Alcali without Calcination, and Sea Salt by Elixation.

Human Urine evaporated and cryſtallized - Fuſible, eſſential, native, microcoſmic, phoſphoric Salt of Urine - Sal Ammoniac - Sea Salt.

Horſes Urine, evaporated to a due Conſiſtency, does not yield a fuſible Salt, but a portion of Sea Salt and a Magma incapable of Cryſtallization.

Earth from the Exſiccation of human Urine rendered white by Calcination - Its habitude to Fire and Menſtruums examined.

Account of Marggraf's Experiments on the fuſible Salt of Urine.

Volatile Alcali ſeparated from freſh Urine by fixed Alcali and by Lime.

Of Eggs.

Whites of Eggs coagulated nearly by the ſame degree of Heat which coagulates the Serum of Blood.

Whites of Eggs coagulable by Acids and by Spirits of Wine - their Uſe in Clarification.

Whites of Eggs diſtilled B. M. Phlegm - Reſiduum.

Reſiduum diſtilled - Volatile Alcali concrete and fluid - Empyreumatic Oil - Caput mortuum.

Oil expreſſed from the Yolks of Eggs.

Of the eſſential Oil, volatile Acid, and expreſſed Oil of Ants.

Of Coral, &c.

Volatile Alcali procured from Coral and Spunges by Diſtillation.

Of Brains and Spermaceti.

Contents of a human Cranium diſtilled - Phlegm - Volatile Alcali - Fetid Oil - Caput mortuum.

Of Fat.

Suet diſtilled - Acid - Congealed Oil - Caput mortuum.

Of Bones and Horns.

Horns rendered ſoft and flexible by boiling in Water.

Ox Horn, Tortoiſe Shell, &c. diſſolved in Acid of Nitre.

Bones ſoftened, and in part diſſolved, by Digeſtion in Acids.

Earth of Bones precipitated from Acids by Alcalies.

Gelatinous and ſaline Part extracted from Hartſhorn by boiling in Water - Method of making Glue - Portable Soop - Iſinglaſs - Size, &c.

Inert Earth remaining after the Extraction of Gelly of Hartſhorn - Cornu Cervi philoſophice Calcinatum.

Hartſhorn diſtilled - Phlegm - Volatile alcaline Salt and Spirit - Air - Empyreumatic Oil - Caput mortuum.

Method of preparing volatile alcaline Salt and Spirit from Bullocks Bones, &c.

Animal Oil diſſolved in Spirits of Wine.

Animal Oil rectified, Oleum Animale Dippelii.

Hiſtory of Putrefaction.

Cauſtic volatile Alcali rendered mild by the Air diſcharged from putreſcent Bodies.

Volatile Alcali ſeparated with the Heat of boiling Water from putrid Blood, Pigeons Dung, and putrid Urine.

Hiſtory of Kunckel's Phoſphorus.

Phoſphorus made by diſtilling evaporated Urine.

Phoſphorus made by diſtilling the Extract of Urine with Plumbum corneum and Charcoal, according to Marggraf's Method.

Phoſphorus made by diſtilling fuſible Salt of Urine and Charcoal together.

Method of rectifying Phoſphorus.

Several Experiments with Phoſphorus.

Of other Vegetables which yield a Phoſphorus by Diſtillation.

Analyſis of the Fæces Alvinæ.

The following Tables of Salts were drawn up and printed ſome years ago; I intended to have made large Additions to them, and to have accompanied them with a Copper-plate, exhibiting the different Figures of all the cryſtallizable Salts hitherto known. I would not however ſuppreſs them in their preſent State, thinking that they might not be unſerviceable to a Student in Chemiſtry.

Tabula Salium in genere.

Sales ſunt	Acidi	Minerales	Vitriolicus,		Sal acidus ſuccini
			Nitroſus,		
			Marinus vel Muriaticus.		
		Vegetabiles	Nativi vel eſſentiales,		Sal acidus Benzöes, &c.
			Acetoſus,	fermentati,	
			Tartareus,		
			Empyreumatici vel ſtillatitii.		
		Animales	Phoſphoricus,		
			Ex formicis, &c. diſtillatione educti.		
	Alcalini	Fixi	Mineralis, ſive Natron.		
			Vegetabilis, ſive lixivioſus.		
		Volatiles —	Igne vel Putrefactione a ſubſtantiis Animalibus, Vegetabilibus, et Foſſilibus quam plurimis, ſeparati.		
	Neutri	Ab Acido quovis conjuncto cum Baſi	Alcalina,		
			Terrea,		
			Metallica.		

Tabula Salium neutrorum, Baſi Alcalinâ.

Acidum	conjunctum cum Alcali	efficit Salem Neutrum, quem vocant
Vitriolicum	Minerali	Salem mirabilem Glauberi.
	Vegetabili	Tartarum vitriolatum, nitrum vitriolatum, Salem de duobus, &c.
	Volatili	Salem ammoniacum ſecretum Glauberi.
Nitroſum	Minerali	Nitrum cubicum.
	Vegetabili	Nitrum commune.
	Volatili	Nitrum flammans vel Ammoniacum.
Marinum	Minerali	Salem communem regeneratum, foſſilem, fontanum.
	Vegetabili	Salem febrifugum vel digeſtivum Sylvii.
	Volatili	Salem Ammoniacum vulgarem.
Acetoſum	Minerali	Salem cryſtalliſantem, nomine non dotatum.
	Vegetabili	Salem diureticum, et improprie Tartarum regeneratum, Terram foliatam Tartar.
	Volatili	Spiritum Mindereri.
Tartareum	Minerali	Salem Repullenſem, Rochelle Salt, Sel de Seignette.
	Vegetabili	Tartarum ſolubilem, Tartarum tartariſatum, Salem vegetabilem.
	Volatili	Tartarum ſolubilem Ammoniacum.
Vegetabilum Acida Nativa, et Stillatitia vel Empyreumatica	Minerali Vegetabili Volatili	Sales cryſtalliſantes varios, nominibus non inſignitos, Chemicis haud penitus exploratos.
Phoſphoricum	Minerali Vegetabili	Sales figuræ variæ, igne borracis inſtar liqueſcentes, non crepitantes.
	Volatili	Salem microcoſmicum, nativum vel fuſibilem Urinæ.
Formicarum	Minerali Vegetabili Volatili	Salem aëre deliqueſcentem. Salem diſtillatione non concreſcentem.

Tabula Salium neutrorum, Baſi Terreâ.

Acidum	conjunctum cum terra	efficit Salem Neutrum nuncupatum
Vitriolicum	Calcarea	Selinitem, Phoſphorum Bononienſem, Gypſum.
	Argillacea	Alumen.
	Vitreſcenti, ab Alcali dejecta	Alumen forſan.
	Magneſiæ	Salem catharticum amarum, vulgo Epſom Salts.
	Aluminis	Alumen regeneratum.
Nitroſum	Calcarea	Nitrum calcareum, Phoſphorum Balduini.
	Argillacea	Alumen nitroſum.
	Vitreſcenti, ab Alcali dejecta	
	Magneſiæ	Salem flavum cryſtalliſantem nitro ſimilem, ſed in aëre deliqueſcentem.
	Aluminis	Maſſam ſalinam Alumine magis ſtipticam in igne fortiori acidum prorſus dimittentem.
Marinum	Calcarea	Salem improprie dictum Ammoniacum fixum, oleum Calcis, Phoſphorum Hombergi.
	Argillacea	Alumen marinum.
	Vitreſcenti, ab Alcali dejecta	
	Magneſiæ	Maſſam deliqueſcentem, vix cryſtalliſationem admittentem.
	Aluminis	Maſſam Salinam.
Acetoſum	Calcarea	Salem cryſtalliſantem, aëre non deliqueſcentem.
	Argillacea	Alumen acetoſum.
	Vitreſcenti, ab Alcali dejecta	
	Magneſiæ	Maſſam viſcoſam, dum calida manet, ſed brevi deliqueſcentem.
	Aluminis	
Tartareum	Calcarea	Salem ſolubilem cryſtalliſantem.

Tabula Salium neutrorum, Baſi Metallicâ, quorum uſus in Artibus et Medicinâ eſt præcipuus.

		conjunctum cum Subſ. Metall.	efficit Salem Neutrum nuncupatum
Acidum	Vitriolicum	Ferro	Vitriolum, vel Cuperoſum viride.
		Cupro	Vitriolum, vel Cuperoſum cœruleum.
		Zinco	Vitriolum album, Goſlarienſe.
		Mercurio	Turpethum minerale.
	Nitroſum	Argento	Cryſtallos lunares, ex quibus Lapis dictus infernalis conficitur.
		Cupro	Maſſam vel Cryſtallos, in Spiritu vini ſolubiles.
		Plumbo	Cryſtallos plumbi, figuræ pyramidalis.
		Mercurio	Cryſtallos Mercurii, unde calx Mercurii, Mercurius præcipitatus ruber, Arcan. Corall.
		Biſmutho	Magiſterium Biſmuthi.
	Marinum	Argento	Lunam corneam.
		Cupro	Maſſam vel Cryſtallos, in Spiritu vini ſolubiles.
		Ferro	Maſſam unde tinctura Martis in ſpiritu ſalis conficitur.
		Plumbo	Plumbum corneum.
		Stanno	Butyrum Stanni, et liquorem fumantem Libavii.
		Mercurio	Sublimatum corroſivum, Præcipitatum Album, Sublimatum dulce, Panaceam Mercurialem.
		Regulo Antim.	Butyrum Antimonii.
	Acetoſum	Plumbo	Ceruſam et Saccharum Saturni.
		Cupro	Viride æris et viride æris diſtillatum.
		Ferro	Tincturas martiales acetoſas.
	Tartareum	Ferro	Rotulas Martiales, Tartarum Chalybeatum.
		Regulo Antim.	Tartarum emeticum.

GEOFFROY's TABLE

1	2	3	4	5	6	7	8
Acids in General	Acid of Sea Salt	Acid of Nitre	Acid of Vitriol	Abſorbent Earths	Fixed Alcaline Salts	Volatile Alcaline Salts	Metalline Subſtances
Fixed Alcaline Salts	Tin	Iron	Phlogiſton	Acid of Vitriol	Acid of Vitriol	Acid of Vitriol	Acid of Sea Salt
Volatile Alcaline Salts	Regulus of Antimony	Copper	Fixed Alcaline Salts	Acid of Nitre	Acid of Nitre	Acid of Nitre	Acid of Vitriol
Abſorbent Earths	Copper	Lead	Volatile Alcaline Salts	Acid of Sea Salt	Acid of Sea Salt	Acid of Sea Salt	Acid of Nitre
Metalline Subſtances	Silver	Mercury	Abſorbent Earths		Diſtilled Vinegar		Diſtilled Vinegar
	Mercury	Silver	Iron		Sulphur		
			Copper				
			Silver				
	Gold						

# of AFFINITIES.

9	10	11	12	13	14	15	16
Sulphur	Mercury	Lead	Copper	Silver	Iron	Regulus of Antimony	Water
Fixed Alcaline Salts	Gold	Silver	Mercury	Lead	Regulus of Antimony	Iron	Spirits of Wine
Iron	Silver	Copper	Calamine	Copper	Silver, Copper, Lead	Silver, Copper, Lead	Neutral Salts
Copper	Lead						
Lead	Copper						
Silver	Zinc						
Regulus of Antimony	Regulus of Antimony						
Mercury							
Gold							

from the Author
to
A. Hume

AN ESSAY ON THE SUBJECTS OF CHEMISTRY, AND THEIR GENERAL DIVISION.

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CAMBRIDGE,
Printed by J. ARCHDEACON Printer to the UNIVERSITY.
M.DCC.LXXI.

AN
ESSAY
ON THE
SUBJECTS OF CHEMISTRY, &c.

ALL terreſtrial exiſtencies may, in one view or other, be conſidered as the ſubjects of Chemiſtry: they are uſually divided into three diſtinct claſſes, called the three kingdoms of nature; the firſt includes Minerals, the ſecond Vegetables, the third Animals. Natural Hiſtory, in an extended ſenſe, comprehends the knowledge of whatever relates to terreſtrial exiſtencies, excluſive of the moral actions of man, which conſtitute the baſis of civil hiſtory; and of the phyſical actions of bodies one upon another, which are the foundation of natural philoſophy.

Mineralogy is that part of natural hiſtory which treats of whatever is found upon the ſurface, or dug out of the bowels of the earth, except animal and vegetable ſubſtances: ſome have excepted water alſo, and denominated that branch of ſcience which explains the properties of water, Hydrology. And indeed, many Chemiſts have thought proper to conſider water, as not appertaining to any of the three kingdoms of nature; but it hath no better right to be diſtinguiſhed from a ſolid, elaſtic, diaphanous mineral, than a melted metal hath to be diſtinguiſhed from the ſame metal when concreted into a ſolid form: in their different ſtates of fluidity and ſolidity they will have different properties; but ſhould not, from ſuch accidental changes as are effected by minute variations of heat, be referred to different claſſes: had water been called melted ice, no one would have ſcrupled to conſider it as belonging to the mineral kingdom.

The reducing quickſilver into a ſolid, malleable metal, by a due degree of cold, was an important diſcovery in phyſics: we learn from thence to conſider all fluid bodies ſuch as water, oils, ſpirits, æthers, and probably the air itſelf, as convertible into ſolids without the introduction of any frigorific particles, but ſimply by a diminution of heat; and all ſolid bodies, as convertible into fluids, without ſuffering any other change in their conſtitution, except what ariſes from the volatilization of ſuch of their principles, as cannot ſuſtain the degree of heat requiſite to render the reſt fluid.

Mineralogy is principally employed in arranging ſimilar bodies under the ſame, and diſſimilar bodies under different denominations. It judges of ſimilarity two ways; either from the ſimilarity of the external appearance, or from the ſimilarity of the internal conſtitution. The knowledge of the ſimilarity of the internal conſtitution of bodies is acquired, chiefly by regarding the changes produced in them by the action of fire, or the action of menſtruums; that of the external appearance by regarding the colour, configuration of the ſuperficial parts, conſiſtency, and weight. From the knowledge of the conſtituent parts of bodies is derived their œconomical

nomical application, their uſe in medicine, agriculture, metallurgy, and other arts: from the ſimilarity of the external appearance, is derived a ſuſpicion concerning the identity of the internal conſtitution; a ſuſpicion, ſerviceable in ſuggeſting conjectures to philoſophic minds, relative to the generation, tranſmutation, and deſtruction of natural bodies.

Moſt Mineraliſts have contented themſelves with claſſing the various ſpecies of Foſſils according to their moſt obvious qualities, and have thereby referred things very heterogeneous to the ſame genus. In the animal and vegetable kingdoms, the external appearance is of eſſential uſe in helping us to reduce them into genera and ſpecies: indeed, when from a reſemblance in one or two particular parts of a plant or an animal; as from the figure of the leaves, or the number of ſtamina; from the ſhape of the hoof, or the number of teeth, we venture to arrange them under the ſame general denomination, great confuſion will ariſe, if we ſuppoſe that general denomination, to infer a reſemblance more extenſive than the idea from whence it was derived: nature often admitting a ſimilarity in ſome particulars coexiſtent with the greateſt diſſimilarity in others: it is not probable however, that Linnæus in claſſing the productions of nature ever entertained ſuch a ſuppoſition, and he ſeems therefore to have been uncandidly cenſured. But when the whole external appearance of a plant, or an animal is taken into conſideration, it is far eaſier to refer it to a particular claſs, than from a chemical enquiry into its internal conſtitution. In fact, the internal conſtitution depends, in a great meaſure, upon the ſame principle from which the external figure is formed. From the configuration of the vaſcular ſyſtem, through which nutrition is conveyed to every part of a plant or an animal, is derived the external figure; and from the ſame configuration the internal properties ſeem to ariſe: for plants become aceſcent or alcaleſcent, ſweet or bitter, poiſonous or ſalubrious according to their different natures, tho' they be planted in the ſame ſoil, and fed with the ſame food, that being changed and elaborated, by proceſſes which we can neither underſtand nor imitate, into different fluids by the different organizations; and, I had almoſt ſaid, digeſtive powers of different plants. The caſe is quite otherwiſe with reſpect to minerals, the external appearances conveying to us little real knowledge; they may be the ſame in different bodies, or different in the ſame body.

Sir Iſaac Newton has proved, that the colours of natural bodies depend upon the thickneſs and denſity of the component parts, and conſequently that minute changes in either of theſe qualities will make very conſiderable changes in the colour: this Philoſophy is confirmed by, and ſerves at the ſame time to explain many appearances in Chemiſtry. Cryſtals of quickſilver in Aqua Fortis are white, yellow, or red, according to the degree of heat to which they have been expoſed; whilſt on the other hand, the ſame quickſilver corroded into a ſaline maſs by Oil of Vitriol, remains perfectly white in all degrees of heat, but by the affuſion of water is changed at once into a vivid yellow, which is of different ſhades according as the water is hot or cold, or as the Maſs hath been more or leſs freed from its adhering acid by calcination. Iron and lead, and moſt other metals undergo ſimilar changes of colour from calcination and precipitation, ſo that nothing ſeems more uncertain than the claſſing of bodies from a reſpect to their colour. This uncertainty of colour, according as the heat is various, is much felt and complained of by Enamellers, and the makers of artificial gems.

The configuration alſo of the ſuperficial parts is a very uncertain characteriſtic of the ſpecific nature of a Mineral: Metallurgiſts are ſenſible of this, they are obliged in many caſes to have recourſe to fire, before they can pronounce concerning the metal contained in an ore, whether it be lead or ſilver, iron or antimony. We have a notable inſtance of this uncertainty in what is called the ſtellated regulus of antimony; the cryſtallization on the ſurface reſembling the radiations of a ſtar, the ſcales of a fiſh, branches of trees, fibrillæ of feathers and other matters, according to certain diverſities of circumſtances attending the proceſs. I do not deny but that a definite degree of liquidity in the Regulus and Scoria, a definite quantity and quality of the Scoria, and a proper preciſion in ſome other matters, would ever produce a definite arrangement of the ſuperficial parts; but it is certain that a ſmall variation in any of theſe, will make a great change in the outward and inward appearance of the Regulus, without affecting in any ſenſible manner its internal compoſition. Another inſtance will ſhew the imperfection of this external method of claſſification ſtill more obviouſly: In ſeveral portions of water let there be diſſolved nitre, ſea ſalt, alum, borax, ſugar, ſaccharum ſaturni, corroſive ſublimate, &c. or any combinations of theſe ſalts, the ſeveral ſolutions will ſtill be equally colourleſs and tranſparent, and by a ſufficient degree of cold ſuddenly applied would be concreted into ſolid bodies, not to be diſtinguiſhed from one another by their colours, figures, conſiſtencies, nor (ſo the experiment might be managed) ſpecific gravities.

By theſe inſtances from Chemiſtry we can apprehend, how there may be a perfect ſimilarity in the external appearances of bodies, when their internal conſtitutions are wholly different, and a diſſimilarity, when they are wholly the ſame. The Minerals produced by nature are analogous to theſe of art, and hence we may infer the great confuſion and obſcurity which muſt neceſſarily attend a natural Hiſtory of Minerals,

nerals, when it is founded only on the external appearance.

Senſible at laſt of this imperfection, the compoſers of ſyſtems of Mineralogy have availed themſelves of the aſſiſtance of Chemiſtry, and have endeavoured to claſs Minerals according to their internal properties. This method is perfect in its kind; and in particular inſtances deſerves greater or leſs attention, according as the analyſis of Minerals is more or leſs complete: in many caſes however it is too general and abſtracted for common uſe. For inſtance, all earths or ſtones which by a certain aſſignable degree of heat, and with a certain quantity of ſaline additions, are convertible into glaſs, may be called vitrifiable earths; all earths or ſtones which in the ſame degree of heat, and with the ſame quantity of ſaline additions, or without them, are not convertible into glaſs, but into quick lime, may be called calcareous earths; and all earths or ſtones which under ſimilar circumſtances remain unaltered in their properties, may, with reſpect to the other two kinds, be called refractory earths. This is all we can learn from Chemiſtry relative to the comparative natures of earths, when expoſed to a given degree of heat; and hence fiſh ſhells, chalk, limeſtones, and marbles would be included in the ſame claſs: but to anſwer the purpoſes of common life, it will be neceſſary to make a more particular diviſion of them, which can only be done after the generic idea hath been eſtabliſhed, by contemplating the external appearances; in which view the colour or figure, or both together, would be principally reſpected; as in fact we ſee they are in the diſtinction of the Italian Antico's, as Marmore Nero, Giallo, Roſſo di ſan guiſto; di Fiorenza, Pæſino; Alberino di Monte Gallicano, &c. all of which are convertible into quicklime, but from their different colours, ſuperficial contextures, and capabilities of receiving different poliſhes, they have become of different values in a commercial light, and therefore are not improperly diſtinguiſhed in a ſyſtem of Mineralogy. In like manner, tho' a chemical examination by fire would probably refer diamonds, emeralds, rubies, topazes, and other ſtones generally denominated precious, to the claſs of flints; yet ſince men have annexed a fanciful value to theſe pebbles from their pellucidity, colour, hardneſs, and other external attributes, it would be a great defect in a mineral ſyſtem not to have them particularly ſpecified and deſcribed.

But to diſcriminate common limeſtones, or common flints into different ſpecies, from a minute variation of the figure or the colour; to claſs pyrites, or combinations of ſulphur and iron, under the ſpecific denominations of ſpherical, hemiſperical, pyramidal, cubical, &c.; to divide, as is uſually done, the ores of the ſame metallic ſubſtance into a great variety of kinds, when an aſſay will give no difference either in the quantity or quality of the metal contained in them, or of the matter by which they are mineraliſed, ſeems to be a multiplicatio entium præter neceſſitatem, and tends rather to obſcure and circumſcribe, than to elucidate and extend our knowledge of nature.

Upon the whole, the great outlines and general diviſions of mineral productions may moſt uſefully be made from a chemical inveſtigation of their conſtituent parts, and where it is expedient for commercial purpoſes to be more particular, an attention to the external appearance will be proper for that end. A Mineraliſt who conſiders gypſeous alabaſters, plaſter ſtone, lamellated gypſums, rhomboidal ſelinites, ſpatum Bononienſe, and a great many other bodies as proper to be diſtinguiſhed from one another, and who is able to aſcribe any particular body to its proper ſpecies from conſidering its external appearance, is poſſeſſed of a particular kind and degree of knowledge: He who beſides being acquainted with the external appearances, is able to prove that all theſe different bodies are compoſed of a calcareous earth, united to the vitriolic acid; and thus make ſeveral ſpecies of things coaleſce together, and unite, as it were, under one general conception, hath a knowledge of theſe bodies different in kind, and ſuperior in degree. By this ſort of knowledge the memory is much relieved, and the mind, ever graſping after univerſal truths, is gratified with the acquiſition of general ideas. Theſe two very different kinds of knowledge belong to every part of Mineralogy, in different views each of them is of indiſpenſable uſe, and a perfect ſyſtem of Mineralogy ſhould include them both.

If it be aſked what are the diſcriminative characteriſtics of Minerals, Vegetables, and Animals as oppoſed to one another, I plainly anſwer that I do not know any either from natural Hiſtory or Chemiſtry which can wholly be relied on.

Syſtematic diſtinctions, and ſpecific diviſions of things, are uſeful in enlarging the comprehenſion of the mind; by methodizing the objects they ſeem to extend the boundaries of knowledge: but having no real foundation in nature, they ſhould not be depended on too far; they often perplex or impede the progreſs of a curious enquirer. This prepoſſeſſion in favour of ſyſtematic arrangements, operates more forcibly upon us as the ideas to which it is uſually annexed become the more abſtracted. The ſtrongeſt analogies are overlooked, the plaineſt reaſonings thought fallacious, and deciſive experiments inconcluſive, when their tendency is to ſubvert a diſtinction, of which we had wrongly ſuppoſed nature herſelf the author. Every one thinks that he knows what an animal is, and how it is contradiſtinguiſhed from a vegetable, and would be offended at having his knowledge queſtioned thereupon.

A dog or a horſe he is truly perſuaded, are beings as clearly diſtinguiſhed from an herb or a tree, as light is from darkneſs; yet as in theſe, ſo in the productions of nature, the tranſition from one to the other is effected by imperceptible gradations.

The loco-motive powers which appertain to moſt animals, whether they proceed from the Carteſian mechaniſm, or from ſenſation, are ſo manifeſt in quadrupeds, birds, fiſhes, and inſects, that in our firſt and ſuperficial enquiries into nature, we are apt to conſider the poſſeſſion or want of theſe powers, as making a deciſive and eſſential difference between animal and vegetable bodies; and it is not without a certain degree of regret, as it were, that we find ourſelves obliged to predicate animality concerning a great variety of beings, which are deſtitute of every power of progreſſive motion. If at the ſame time we happen to have entertained ſome preconceived opinions, no matter whence they have been derived, concerning the uſual ſhapes of animals, (tho' they are far more different from one another than ſome of them are from vegetables) our repugnancy to the admitting a being of the outward form of a ſhrub, into the claſs of animals, is much increaſed. Hence have proceeded moſt of the objections which have been made to the fine diſcoveries of Peyſſonel, Juſſieu, Ellis and others, relative to the animal nature of corals, madrepores, millepores, corallines, ſpunges, and a numerous tribe of bodies which the very ingenious labours of Marſigli had formerly removed from the mineral kingdom, where they had been placed by Woodward and other Mineraliſts, and allotted to that of vegetables.

If rejecting ſpontaneous motion and figure as very inadequate teſts of animality, we adopt perception in their ſtead; no doubt, he would be eſteemed a viſionary in Philoſophy who ſhould extend that faculty to vegetables; and yet there are ſeveral chemical, phyſical, and metaphyſical reaſons which ſeem to render the ſuppoſition not altogether indefenſible.

The greater the quantity of perception exiſting in the univerſal ſyſtem of creation, the greater is the quantity of happineſs produced; and the greater the quantity of happineſs produced, the greater is the goodneſs of the Deity in the eſtimation of

Beings with our capacities. The latter part of this propoſition needs no proof; and the former is liable but to one objection, and that grounded upon a falſe ſuppoſition. If, it may be urged, all the ſpecies of percipient beings be not accommodated with objects congruous to their faculties of perception, and productive of more pleaſure than pain to the whole ſpecies taken collectively, then the animation of that matter of which they conſiſt is an introduction of evil, and no teſt of benevolence. This may be granted; but in all the ſpecies of beings which come within the obſervation of our ſenſes, the ſuppoſition of their not being furniſhed with objects ſuited to their wellbeing is evidently not true, and therefore ought, from analogy, to be rejected with reference to ſuch as by their magnitude, their minuteneſs, or their dullneſs of perception eſcape our examination.

That animals ſhould feed one upon another, is a law of nature full of wiſdom and goodneſs, life and happineſs being indefinitely multiplied thereby. For a given quantity of what are called vegetables, annually produced upon a globe of a given diameter, being ſufficient but for the ſupport of a given number of herbaceous animals, whoſe place in the univerſe not admitting their immortality, it hath been wiſely contrived that their bodies, which from their ſtructure muſt periſh, ſhould in ceaſing to live, become the inſtruments of ſupporting life in beings, which could not by any other means have had an exiſtence, at leaſt upon this globe; and of the other parts of the univerſe we know nothing except from analogy, and from that we muſt conclude that the τὸ πᾶν, be it finite or infinite, is as full of life as this particular part with which we are connected. Nay, animated matter, containing as it were the concentrated virtue of many vegetables, ſerves for the ſupport of life, and the conſequent communication of happineſs in a far more ample manner than vegetables themſelves; animal ſubſtances in equal weights furniſhing more nutriment than vegetable. It is by death, a ſeeming imperfection in his workmanſhip, that the Deity preſerves vegetable life, ſupports the animal kingdom, daily regulates and renews the œconomy of nature, and continues this wonderful ſyſtem of things in full youth and vigour, nor interrupted by diſeaſe, nor enfeebled by old age.

No objection therefore to the animality of vegetables can be brought from any conſiderations reſpecting their daily deſtruction; for the deſtruction of animals by other animals, the bellum omnium in omnia, is an univerſal law of nature, derived from the ſame benevolence to which we attribute creation itſelf. If then every part of the vegetable kingdom hath a degree of perceptivity, however ſmall, there will be a gain of happineſs to the whole ſyſtem, the aggregate may be of a value not to be overlooked by him, to whom the exiſtence of all things is equally poſſible, and from whom all created exiſtences are equally diſtant in perfection.

Wherever there is a vaſcular ſyſtem, containing a moving nutritive ſuccus, there is life; and wherever there is life there may be, for ought we can prove to the contrary, a more or leſs acute perception, a greater or leſs capacity for the reception of happineſs: the quantity, indeed, of which after we have deſcended below a certain degree of ſenſibility, will, (according to our method of eſtimating things, which is ever partial and relative to ourſelves) be ſmall in each individual; yet is the exiſtence of it in the nature of things poſſible, from the analogy of nature probable: and who can tell whether in a ſyſtem of nature, confeſſedly contrived for the production of the greateſt poſſible good, it may not alſo be neceſſary?

It ſhould be well weighed by the Metaphyſicians, whether they can exclude vegetables from the poſſeſſion of the faculty of perception, by any other than comparative arguments; and whether the ſame kind of comparative reaſoning will not equally exclude from animality thoſe animals which are provided with the feweſt and the obtuſeſt ſenſes, when compared with ſuch as are furniſhed with the moſt and the acuteſt. The perception of a man (tho' it may be doubted whether there are not ſeveral animals which have all the ſenſes more acute) ſeems to be indefinitely greater when compared with that of corallines, ſea-pens, and oyſters, than the perception of theſe, which are allowed to be animals, doth when compared with the ſigns of perception manifeſted by a variety of what are called vegetables. Spunges open and ſhut their mamillæ, corals and ſea-pens protrude or draw back their ſuckers, ſhell-fiſh open or keep cloſe their ſhells in ſearch of food or avoidance of injury; it is from theſe and ſimilar muſcular motions that we judge the beings to which they belong to have perception, that is, to be animals. Now in the vegetable kingdom, we may obſerve the muſcular motions of many plants to be, to the full, as definite and diſtinguiſhable as thoſe of the claſs of animals juſt mentioned. The plants called Heliotropæ turn daily round with the ſun; by conſtantly preſenting their ſurfaces to that luminary, they ſeem as deſirous of abſorbing a nutriment from its rays, as a bed of muſcles doth from the water, by opening their ſhells upon the afflux of the tide. The Flores Solares are as uniform in their opening and ſhutting as animals are in their times of feeding and digeſting; ſome in theſe motions do not obſerve the ſeaſons of the year, but expand and ſhut up their flowers at the ſame hour in all ſeaſons; others, like a variety of inſects which appear, or not, according to the heat of the weather or climate, open later in the day, or do not open at all, when they are removed from a ſouthern to a more northern latitude. Trefoil, woodſorrel, mountain ebony, wild ſenna, the African marigold, &c. are ſo regular in folding up their leaves before rainy weather, that they ſeem to have a kind of inſtinct or foreſight ſimilar to that of ants; which however deſerts many of them as ſoon as they have propagated their kind, by ſhedding their pollen. Young trees, in a thick foreſt, are found to incline themſelves towards that part through which the light penetrates, as plants are obſerved to do in a darkened chamber towards a ſtream of light let in through an orifice, and as the ears of corn do towards the ſouth. The roots of plants are known to turn away with a kind of abhorrence from whatever they meet with which is hurtful to them, and to deſert their ordinary direction, and to tend with a kind of natural and irreſiſtible impulſe toward collections of water placed within their reach: many plants experience convulſions of their ſtamina upon being ſlightly touched. Whatever can produce any effect upon an animal organ, as the impact of external bodies, heat and cold, the vapour of burning ſulphur, of volatile alcali, want of air, &c. are found to act alſo upon the plants called ſenſitive. But not to inſiſt upon any more inſtances, the muſcular motions of the Dionæa Muſcipula lately brought into Europe from America, ſeem far ſuperior in quickneſs to thoſe of a variety of animals. Now to refer the muſcular motions of ſhell fiſh, and zoophytes, to an internal principle of volition, to make them indicative of the perceptivity of the being; and to attribute the more notable ones of vegetables, to certain mechanical dilatations, and contractions of parts occaſioned by external impulſe, is to err againſt that rule of philoſophyzing which aſſigns the ſame cauſes for effects of the ſame kind. The motions in both caſes are equally accommodated to the preſervation of the being to which they belong, are equally diſtinct and uniform, and ſhould be equally derived from mechaniſm, or equally admitted as criterions of perception.

I am ſenſible that theſe and other ſimilar motions of vegetables, may by ſome be conſidered as analogous to the automatic or involuntary motions of animals; but as it is not yet determined amongſt the Phyſiologiſts, whether the motion of the heart, the periſtaltic motion of the bowels, the contractions obſervable upon external impulſe in the muſcles of animals deprived of their heads and hearts, be attributable to an irritability unaccompanied with perceptivity, or to an uneaſy ſenſation, there ſeems to be no reaſon for entering into ſo obſcure a diſquiſition; eſpecially ſince irritability, if admitted as the cauſe of the motions of vegetables, muſt, a fortiori, be admitted as the cauſe of the leſs exquiſite and diſcernible motions of beings univerſally referred to the animal kingdom.

Phyſical obſervations concerning the generation, nutrition, organization, life, health, ſickneſs, and death of plants, help us as little towards the eſtabliſhing a diſcriminative characteriſtic between them and animals, as metaphyſical ſpeculations relative to the quantity of happineſs, or degrees of perceptivity.

The eaſtern practice of fœcundating the female palm tree by ſhaking over it the duſt of the male, which Herodotus mentions in his account of the country about Babylon, and of which Dr. Haſſelquiſt in the year 1750 was an eye witneſs, was not unknown to Ariſtotle and Pliny: but the

Ancients ſeem not to have carried the ſexual ſyſtem beyond that ſingle inſtance, which was of ſo remarkable a kind that it was hardly poſſible for them to overlook it; at preſent there are few Botaniſts in Europe who do not admit its univerſality. It ſeems generally agreed, that a communication of ſexes in order to produce their like belongs to vegetables as well as to animals. The diſputes ſubſiſting among the Anatomiſts concerning the manner in which conception is accompliſhed, whether every animal be produced ab ovo femellæ, or a vermiculo in ſemine maris, are exactly ſimilar to thoſe amongſt Botaniſts concerning the manner in which the farina fœcundans contributes to the rendering the ſeed prolific: but however theſe doubts may be determined, they affect not the preſent enquiry, ſince it is allowed on all hands, that as the eggs of oviparous animals, tho' they arrive at their full magnitude, are incapable of being vivified by incubation, unleſs the female hath had commerce with the male: ſo the dates of female palm trees, and the fruits of other plants, tho' they ripen, and arrive at maturity, will not grow unleſs they have been fœcundated by the pollen of the male.

In like manner notwithſtanding the diverſity of opinion which hath long ſubſiſted, and in a matter ſo little capable of being enlightened by experiment, probably ever will ſubſiſt, concerning the modus agendi by which nature elaborates the nutritive fluid, adminiſters it to the fœtus in the womb, and produces an extenſion of parts; yet ſince a placenta and an umbilical chord are by all thought eſſential to the effecting theſe ends; and ſince the cotyledons of plants, which include the corculum or firſt principle of the future plant, with which they communicate by means of tubes branched out into infinite ramifications, are wholly analogous to the placenta and umbilical chord of animals, we have great reaſon to ſuppoſe that the embryo plant and the embryo animal are nouriſhed and dilated in their dimenſions after the ſame way. This analogy might be extended and confirmed by obſerving that the lobes, within which the fœcundated germ is placed, are by putrefaction converted into a milky fluid, well adapted as an aliment to the tender ſtate of the plant.

Exſpiration and inſpiration, a kind of larynx and lungs, perſpiration, imbibition, arteries, veins, lacteals, an organized body, and probably a circulating fluid appertain to vegetables as well as to animals. Life belongs alike to both kingdoms, and ſeems to depend upon the ſame principle in both: ſtop the motion of the fluids in an animal limb by a ſtrong ligature, the limb mortifies beyond the ligature, and drops off; a branch of a tree under like circumſtances, grows dry, and rots away. Health and ſickneſs are only other terms for tendencies to prolong or to abridge the period of life, and therefore muſt belong to both vegetables and animals, as being both poſſeſſed of life. An eaſt wind, in our climate, by its lack of moiſture, is prejudicial to both; both are ſubject to be froſt bitten, and to conſequent mortifications; both languiſh in exceſſive heats; both experience extravaſations of juices from repletion, and pinings from inanition; both can ſuffer amputation of limbs without being deprived of life, and in a ſimilar manner both form a callus; both are liable to contracting diſeaſes by infection; both are ſtrengthened by air and motion: Alpine plants, and ſuch as are expoſed to frequent agitation from winds, being far firmer and longer lived than thoſe which grow in ſhady groves, or hot houſes; both are incapable of aſſimilating to their proper ſubſtance all kinds of food; for fruits are found to taſte of the ſoil, juſt as the urine, and milk, and fleſh, and bones of animals, often give indications of the particular pabulum with which they have been fed: both die of old age, from exceſs of hunger or thirſt, from external injuries, from intemperature of weather, or poiſoned food.

Seeds of various kinds retain their vegetative powers for many years: the vivification of the ova, from which the inſects occaſioning the ſmut in corn, and the infuſoria animalcula obſervable in water after the maceration of plants probably proceed, may be eſteemed a ſimilar phænomenon. It is not yet clearly decided amongſt Naturaliſts, whether the ſeeds of muſhrooms, of mucors, and of the whole claſs of Fungi be not in a tepid, humid matrix changed into vermicular animals, which loſe in a little time their power of ſpontaneous motion, coaleſce together, and grow up into theſe very ſingular plants:

the quickneſs of their increaſe, and the irreſiſtible force with which the leaſt mouldineſs propagates itſelf, and deſtroys the texture of the bodies upon which it fixes, ſeem to point towards an animal nature.

Different vegetables require different ſoils, as different animals do different food for their ſupport and well being: aquatics pine away in dry ſandy grounds, and plants which love rocks and barren ſituations, where they imbibe their chief nutriment from the air, become diſeaſed and putrid in rich bogs and ſwamps.

There are aquatic animals which become immoveable and lifeleſs when the rivulets in which they ſubſiſted happen to be dried up, but which recover their life and loco-motive powers upon the deſcent of rain: in this circumſtance they are analogous to the claſs of moſſes among vegetables, which, tho' they appear to be dried up, and ready to crumble into duſt during the heats of ſummer, yet recover their verdure and vegetable life in winter, or, upon being put into a humid ſoil.

Trembley, Bonnet, and Spallanzani have vaſtly amplified our views of nature; they have diſcovered to us divers ſpecies of animals, which may be cut into a variety of pieces without loſing their animal life, each piece growing up into a perfect animal of the ſame kind: the multiplication of vegetables by the planting of branches, ſuckers, or joints of roots is a ſimilar effect. The reproduction of the legs of craw-fiſh, lobſters, crabs, of the horns and heads of ſnails, legs of lizards, of the bony legs and tails of ſalamanders, when by accident or deſign they have been deprived of them; and the great difference in the time of the reproduction, according to the ſeaſon of the year in which the limb is loſt, are wonders in the animal kingdom, but wholly analogous to the repullulation of trees after lopping.

All plants, except thoſe of the claſſes Monæcia and Diæcia, are hermaphrodites; that is, they have the male and female organs of generation within the ſame empalement. Shell-fiſh, and ſuch other animals as reſemble vegetables in not being able to move far in ſearch of mates, with which they might propagate their kind, are hermaphrodites alſo: Reaumur hath proved that vine fretters do not want an union of ſexes for the multiplication of their kind.

From the conjunction of animals of different ſpecies are produced hybrides, which in many caſes cannot propagate: Botaniſts have tried the experiment, and by fœcundating female flowers with the male duſt of another ſpecies, have produced hybridous plants, of an intermediate ſhape, the ſeeds of which are barren and effete.

Trees ſhed their leaves as birds do their feathers, and hirſute animals their hair. At particular ſeaſons the juices of vegetables move with fullneſs and vigour; at others they are leſs plentiful, and ſeem to ſtagnate; and in this they reſemble dormice, bats, frogs, and numberleſs other animals of cold blood, which lie torpid and deſtitute of every ſign of life during the winter time; the action of the lungs and of the heart being, if any, imperceptibly weak and languid.

Few, if any animals can exiſt without a reciprocal ſucceſſion of ſleep and vigilance, and the younger the animal, the greater is its propenſity to ſleep: the ſame alternatives ſeem neceſſary for the health of ſeveral vegetables; a great variety of plants fold up their leaves, and ſeemingly compoſe themſelves to reſt, in the night time, and this diſpoſition for ſleep is more remarkable in young plants than in old ones; nor does it, as might be ſuſpected, depend upon the influence of light or heat, ſince plants in hot houſes, where the heat is kept at the ſame degree, fold up their leaves at a ſtated time in the evening, and expand them in the morning, whether the light be let in upon them or not. It may deſerve to be enquired, whether by a relaxation of fibres theſe plants become ſubject to a more copious perſpiration during ſleep than in their ſtate of vigilance, as Sanctorius hath proved to be the caſe in animals.

There is a great diverſity, but a regular ſucceſſion in the times, in which animals of different ſpecies feel the œſtrum, by which they are ſtimulated to the propagation of their reſpective kinds: an order equally determined, is obſervable in the times of accompliſhing the ſponſalia of plants. The periods of incubation in oviparous, and of geſtation in viviparous animals are not more various in different ſpecies, nor probably more definite in the ſame, than the periods requiſite for the germination and maturation of different ſeeds. By the influence of heat and cold, abundance and ſcarcity of nouriſhment, the ſeaſons of propagating may be ſomewhat accelerated or retarded in animals as well as in vegetables: the effects of a cold ungenial ſpring are as remarkable in the retardation of the procreative intercourſes of birds and beaſts, as in the ſtoppage of the leafing of trees, or the flowering of ſhrubs. In a word, there are ſo many circumſtances in which the anatomy and phyſiology of ſome plants agree with thoſe of ſome animals, that few, I believe, can be mentioned in which they diſagree.

When it is conſidered that animals are either mediately or immediately wholly nouriſhed from vegetables, it might be expected, a priori, that the products obtainable by a chemical analyſis from the two kingdoms ſhould be different rather in quantity than quality, and that we could not from thence diſcover any criteria by which they might be diſtinguiſhed from one another: this obſervation is confirmed by experiment. Animals, it is true, in general yield a greater proportion of a volatile alcaline, than of an acid ſalt by diſtillation; vegetables on the contrary abound in acid, and yield not any volatile alcali, unleſs with the laſt degree of heat, or when they have undergone putrefaction: in ſaying this, I am aware that I differ from the opinion commonly received. Muſtard ſeed, water creſſes, horſe-radiſh, and other plants of the tetradynamia claſs are generally ſaid to contain a volatile alcali already formed, and to yield it with the heat of boiling water; from none of theſe however could I ever obtain B. M. a phlegm which would give a precipitation with corroſive ſublimate, the moſt indubitable teſt of a fluid's containing even the minuteſt portion of volatile alcali; the pungent ſmell ſeems to have been miſtaken here, as Sir John Pringle hath well obſerved the fœtor to have been in the putrefaction of many animal ſubſtances, as proceeding from a volatile alcali; and which may, perhaps, be with greater truth attributed to a volatile oil, a ſmall portion of which is ſometimes procurable from pepperwort, by the heat of boiling water impregnated with ſea ſalt. However, as ſome animals, and ſome parts of moſt animals yield a portion of acid, and as moſt vegetables, by a ſtrong fire in cloſe veſſels, or when converted into ſoot, afford a volatile alcali, altogether ſimilar to that obtained from animal ſubſtances, we cannot from theſe circumſtances eſtabliſh any diſtinctive mark between the two kingdoms.

With reſpect to Minerals indeed, Chemiſts think that they have found out an infallible and univerſal Criterion, by which they may be diſtinguiſhed from every animal or vegetable ſubſtance. All bodies from which we can obtain an oil by diſtillation, or otherwiſe, are ſuppoſed to belong to ſuch ſubſtances as have enjoyed an organic life; no mineral, it is ſaid, containing any: this is a ſenſible diſtinction, and yet it is not perhaps in extreme caſes wholly to be relied upon. When a vegetable or animal is diſtilled in cloſe veſſels, the ſtronger the fire is, the more oil is obtained; what firſt paſſes into the recipient is more clear and limpid than what comes over towards the end of the operation; it may be preſumed however, that what remains adherent to the coal in the retort, and which no violence of fire can ſeparate, is not eſſentially different from the laſt portions which are diſtilled; yet this, be it fixed oil or phlogiſton, is no wiſe different from what enters into the compoſition of metallic ſubſtances, and of minerals, perhaps, of all kinds. Zinc burns with a flame reſembling that of charcoal; lead and tin burn like rotten wood; iron and other metals may be burnt to aſhes in the open air, but like charcoal cannot be decompoſed in cloſe veſſels; ſpirits of wine burn like ſulphur, charcoal and metallic ſubſtances without producing any ſoot; yet from ſpirits of wine an oil may be obtained: Why ſhould the phlogiſton of metals be thought of a nature wholly different from the oil which ſo obſtinately adheres to charcoal, or from that which ſeems to enter into the compoſition of vinous ſpirits?

Naturaliſts, as well as Chemiſts, have perhaps too precipitately embraced the opinion, that Minerals may be certainly and readily diſtinguiſhed from the other two kingdoms. A vaſcular ſyſtem, a nutritive ſuccus, and a power of producing its like, conſtitute the abſtract idea both of a vegetable and an animal, as contradiſtinguiſhed from a mineral: this idea is clear and definite in itſelf; but to determine how far the coexiſtence of theſe qualities is in the nature of things neceſſary, or where any of them ceaſes to exiſt, is a queſtion of vaſt difficulty when applied to particular caſes. Stones dug out of quarries, ores out of mines, in general, minerals ſeparated from their matrices are like the dead branches or limbs of vegetables or animals, incapable of receiving increaſe, except from an external incruſtation; but whether the matrices themſelves increaſe, or that being in ſome caſes granted; whether they receive their augmentation from an external appoſition, or an internal aſſimilation and extenſion of parts, cannot readily be decided either way. In the Cretan labyrinth it hath been obſerved, that the names of travellers, which have been cut in the rock in former ages, are now in alto relievo, and that the older the dates are, the greater is the protuberance, reſembling the callus formed by inciſions in trees: In the mines of Chremnitz in Hungary, which have been wrought for above one thouſand years, the antient roads which had been cut through the rocks are left to grow up; and it is remarked, that they approach one another in a horizontal, and not in a perpendicular direction; the ſame phænomenon may be obſerved in the marble quarries in Italy, as is mentioned by Baglivy in his treatiſe upon the vegetation of ſtones; but whether theſe, and many ſimilar appearances are to be attributed to the preſſure of the ſuperincumbent ſtrata, or to a kind of vegetable growth, is a doubtful point. Rock cryſtals, amethyſts, and various precious ſtones have been thought by De Boot and others to grow like muſhrooms; certain it is, that they often contain in them ſeveral heterogeneous particles; a circumſtance which proves them to have been once in a fluid ſtate, and induces a ſuſpicion that in their formation they may reſemble the gums and reſins extravaſated from various ſpecies of vegetables. The vegetation of ſtones hath been admitted by many, and ſome have contended that minerals as well as animals and vegetables ſpring from ſeed, the greateſt rock being nothing but the expanſion of the parts of a minute grain of ſand.

Salts diſſolved in water conſiſt of indefinitely ſmall moleculæ, which, as far as microſcopes can inform us, are ſimilar in figure to the large cryſtals which become viſible to the naked eye, and which are formed, as it were, from the expanſion of one particle: it will be eaſily underſtood, how conformable this mineral cryſtallization is to the opinion of thoſe, who attribute the growth of animals and vegetables to the accretion of organic particles of the ſame kind. The concentrick cruſts of which ſtalactites conſiſt, are not either in their appearance, or their formation, perhaps, unlike the circles annually produced by the ſtagnation of the ſap in the boll and branches of trees. The native gold and ſilver tufts, which appear to burſt through the hardeſt rocks, and which from their great reſemblance to trees, have been called by ſome arboreſcent, ſeem to indicate a kind of vegetation in their formation.

Suppoſing, however, that we pay no attention to any of theſe circumſtances, yet cannot we form any judgement concerning the internal ſtate of the earth. The greateſt depths to which Miners have penetrated even in mountainous countries, which may be conſidered as excreſcencies from the true ſurface of the earth, or the level of the ſea, have ſcarcely ever equalled one ſixteen thouſandth part of its diameter; a diſtance altogether inſufficient for the forming any probable conjecture about the inward conſtitution of the globe. The ſtrata of ſtones, and veins of minerals, which are met with upon the ſurface, can give us as little information concerning the internal ſtructure of the earth from which theſe are probably derived, as the contemplation of the ſcales of a fiſh, the feathers of a bird, or the Epidermis of a man, would concerning the bones and muſcles, the veins and arteries, the circulation of the blood, and the ſeveral ſecretions of an animal body. Many minerals ſeem in their formation to have been antecedent, others ſubſequent to the univerſal deluge; a great part of the matter conſtituting the outward ſhell of the earth, the only part which we can examine, hath been ſubſervient to vegetable or animal life. All the ſtrata of limeſtones, chalks, marbles, all gypſums, ſpars, alabaſters, &c. are confeſſedly of animal origin. The ſtrata of pitcoal, and of all bituminous foſſils, of ſome ſpecies of ſlates, whatever may be thought of argillaceous ſtrata in general, the mould every where covering the ſurface of the earth, and other ſubſtances are ſuppoſed probably enough, to have ariſen from the deſtruction of vegetables, ſo that I know not whether it would be a very extravagant conjecture which ſhould ſuppoſe that all matter is, or hath been organized, enlivened, animated.

Hence may it appear probable, with reverence yet, and conſcious ignorance be it ſpoken, that the One, Eternal, Incomprehenſible God hath eſtabliſhed an uninterrupted concatenation in all his works, which he hath ſubmitted to our view. Different individuals hath he mingled together into the ſame ſpecies; different ſpecies into the ſame genus; different genera into the ſame kingdom; and different kingdoms he hath diſtinguiſhed, perhaps, but by lines of diviſion too minute for our obſervation. This ſtrong analogy by which men and minerals, and all intermediate exiſtencies are bound together in a common chain, and thence, it would ſeem, naturally ſubjected to a common fate, may appear humiliating to ſuch as have been wont to entertain high notions of the phyſical dignity of human nature: but it cannot offend nor diſquiet thoſe, who feel within themſelves faculties eſſential to the conſtitution of moral agency, and who from thence become capable at leaſt of retribution of puniſhment or reward in another ſtate.

In the number of our ſenſes, and in the modifications of the intellectual faculties which ſpring therefrom, we have a great reſemblance to many animals which inhabit this planet as well as we. The genus to which man belongs includes a great many ſubordinate ſpecies; or, to ſpeak in a manner more conformable to nature, and more conſonant to the account we have of its origin, the human ſpecies from the diverſities of climate and of food, from changes introduced by diſeaſe, and continued, perhaps, by propagation, and from other cauſes which are unknown to us, hath been branched out into a great many varieties: theſe, however, are as much diſtinguiſhed in ſhape and intellect from one another, as they are from animals which have ſprung from a different ſtock. Anatomiſts, whether they conſider the brain as an inſtrumental, or an efficient cauſe of intelligence, are agreed in acknowledging a great reſemblance between the contents of the human cranium and thoſe of quadrupeds; and Putius hath proved, contrary to the opinion embraced by Pliny, and commonly received, that we have not that medullary ſubſtance in a greater proportion than other animals. Nor are we characteriſed by a circumſtance generally eſteemed eſſentially neceſſary to the ſupport of the human fœtus, and excluſively appertaining to our ſpecies: nations are mentioned to whom it doth not belong, and whatever degree of credit may be given to that narration, it is certain that a great many ſpecies of animals have been diſcovered to which it doth. Notwithſtanding this analogy by which we are to be claſſed with the reſt of the animals around us, yet hath it pleaſed Him who called forth from nothing both us and them, and thankful we ought to be for the preference, to place us at the top of the ſcale, to make us, as it were, the firſt term of a ſeries, deſcending indefinitely by imperceptible gradations, to particularize that claſs of animals to which we belong, by rendering it capable of forming a moral character. This capability, it is true, is various according to the opportunities of, and capacities for receiving inſtruction in different ſpecies, and in different individuals of the ſame ſpecies: the Orangoutang of the woods of Java, the apron-bellied Caffre of the Cape, the woolly-headed Negro of Africa, the beardleſs Savage of America, the dwarfiſh Inhabitant of the Frigid Zone, the moon-eyed Albino, and the enlightened European, are as different from one another in this circumſtance as in outward form: yet wherever it exiſts even in the ſmalleſt degree, there ariſeth a proportionable imputability of conduct, a kind of title to the natural or covenanted good, a reaſonable ſubjection to the natural or poſitive evil, which God hath annexed as ſanctions to the laws which he hath thought fit to preſcribe for the regulation of the moral conduct of mankind.

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ET
CHEMIÆ PROFESSORIS
IN ACADEMIA CANTABRIGIENSI,

INSTITUTIONUM CHEMICARUM
IN PRÆLECTIONIBUS ACADEMICIS
EXPLICATARUM,

PARS METALLURGICA.

CANTABRIGIÆ,
Typis Academicis Excudebat J. ARCHDEACON.
M.DCC.LXVIII.

PRÆFATIO.

MIRUM profecto et incredibile dictu eſt, quam late per univerſas Europæ regiones ſeſe dilataverit Philoſophia Naturalis, ex quo Peripateticorum atque Ariſtotelis Auctoritatem fregerit Baconus. Hinc æque ſingulorum, ac Societatum et Academiarum Laboribus Commentariiſque, adeo jam diffuſa eſt undique et diſſeminata, ut ingentes ejus Auctus et Progreſſus Cogitatione vix quiſquam poterit complecti.

Jacebat interea *Chemia* parcius et infrequentius culta, ſanis pleriſque ſuſpecta, et, Alchemicorum propter deliramenta, ab ipſa Legum noſtrarum auctoritate improbata. At ut aliis rebus humanis ita etiam et Artium ſcientiis accidit, quæ nec in imo gradu neque in faſtigio moram patiuntur.

PRÆFATIO.

Chemiam, quam haud ita pridem fuiſſe audivimus domi ſqualidam, fuligine infuſcatam, et præ hominum ei deditorum pauperie pene ridiculam, foris per trivia miſere vagantem, inhianti paſſim popello præſtigias ſuas venditantem, a nemine fere non conculcatam et deſpectui habitam, noſtris tandem temporibus ſeſe alacrius erigentem, focillatam demum a Principibus, et a Philoſophis ubique excultam auſpicato ſatis admiramur. Eò quidem jam perducta eſt, ut quæ inter præcipuas plane doctrinas reponatur omnino digna ſit, cum nec in Principiorum perſpicuitate nec in Concluſionum pondere, ſive philoſophicos ſeu civiles reſpicias uſus, ulli ſcientiarum cedat.

Chemia genere *duplex* eſt; corpora vel *reſolvit* vel *componit.* Reſolutio corporum iiſdem, quibus ipſa eorum varietas ſpecifica, terminis definitur; ſingulorum abſoluta eſſe habetur cum ad *Elementa* vel principia homogenea, ſive plura ſint ſive pauciora, perducatur. — Compoſitio corporum, Geometriæ inſtar eſt infinita.

Partium Animalium figuram, nexum, et motum Anatomici; Vegetabilium fabricam Botanici; Foſſilium ſitus atque habitus externos Mineralogici; non formas rerum ſed mixtiones Chemici, perſcrutantur.

Actiones Medicamentorum in corpora animalium tractat *Therapeutice.* Chemia autem quippe quæ reſolvat mixta, reſoluta conjungat, et varia quæ inde exoriantur phænomena dignoſcat Therapeutices ſit quaſi anima: at cum infinitas ſimul aliorum corporum naturas retegat, et actiones mutuas inveſtiget, ad univerſam potius Phyſicen, quam ad ſolam medicinam, tanquam ad ſuum ac proprium finem refertur.

PRÆFATIO.

Mechanica tum Phyſices tum Chemiæ ſanioris fundamenta feliciter poſuit *Newtonus*; cum de mutuis corporum Attractionibus, vel, ut Chemici loquuntur Affinitatibus, ex quibus omnis eorum Reſolutio et Compoſitio pendet, in quæſtionibus quibuſdam ſuo de re optica libello adjectis quam ſagaciſſime diſceptavit: fundamento jam poſito molem extruxere paululum Recentiores, felici admodum ſolertia; nec Ædificio Adminiculum nec forma deeſt: Faſtigium Operi quod infinitum eſt, nulla ingeniorum ſagacitas, nulla temporum diuturnitas unquam imponet.

In *Theoreticam* et *Practicam* commode dividi poteſt Chemia: hæc quæ Encheireſes docet, Opificum eſt; illa quæ veritatem exquirit, Philoſophorum. Veritatis indagatio omnis eſt Philoſophiæ finis, hæc autem veritas inter phyſicos cognitione rerum experimentis eruenda continetur.

tinetur. Chemia quoque infinitam propemodum experimentorum, cum multis ante ſeculis tum noſtra etiam ætate inſtitutorum, copiam complectitur, atque iiſdem univerſa nititur.

Notiora tanquam ignota proferre, depeculari aliena, antiqua undique corraſa tanquam nova ac propria venditare, hominis eſt otio abutentis: At ſimulata a ſinceris diſtinguere, dubia ſecernere a certis, indigeſtis nexum quendam conciliare et ordinem, obſcuriora illuminare, infinitis modum ſtatuere, arduum ſane ſed nec inutile nec inhoneſtum eſt. Quod ſi magno cum diſcentium commodo, in aliis philoſophiæ naturalis partibus abſolutum hocce vidimus, quid obſtat quo minus in Chemia quoque induſtriæ aliquid periclitemur? Hac mente Provinciam mihi ab Alma Matre demandatam, *Regis Ornatiſſimi* munificentia inſignitam ſimul ac ditatam, quantum in me fuerit colui, et colam.

PRÆFATIO.

Lectores nihil hic reperient præter *Corporum Metallicorum Affectiones* cum alienis tum meis quibuſdam experimentis enucleatas; quas in ſeriem Propoſitionum, brevem quidem at Lectionibus publicis explicandam et illuſtrandam redegi.

Opuſculum hoc Tyronum gratia, currente calamo conſcriptum, utcunque imperfectum et provectiorum notitia indignum, iis qui Chemiam a limine tantum ſalutant, vix erit inutile. Et cum nollem id extra Academiæ pomœrium evagari aut publici fieri juris, erroris ſi quid aut incuria fuderit, aut ab ipſius operis obſcuritate et difficultate irrepſerit, id ſolita pro ſua humanitate condonent oro, qui hic loci Chemiæ operam navarunt: iiſque mei adverſum ipſos ſtudii, pietatis erga Academiam hoc qualecunque Teſtimonium, omni cum cultu et obſervantia, dico atque dedico.

CAP. I.

Definitiones.

1 CORPORA quæ ponderis decrementum in igne fortiſſimo non patiuntur *Fixa* vocantur, quæ patiuntur *Volatilia*; idque magis aut minus prout majori aut minori negotio partes eorum igne diſſipantur.

2 *Partes volatiles* corporis, quæ fluidæ ſunt et ignis vi in auras agantur, *evaporari* dicuntur; cum in vaſe clauſo ſtillatim condenſentur, *diſtillari*; *Solidæ* vero, cum ſurſum evectæ in forma ſolida condenſentur, *ſublimari* dicuntur: atque hæ vel *Sublimata* vel *Flores* vocantur, prout maſſam compactam, vel pulverem friabilem efficiunt.

3 Fluidum quodvis, ſolido affuſum et ab eo diſtillatione ſeparatum, dicitur ab eo *abſtrahi.*

4 Cum partes aquoſæ fluidi cujuſvis compoſiti ab eo ſeparantur, ſive diſtillatione, ſive corporum aquam vel phlegma abſorbentium interventu, ſive conglaciatione, fluidum remanens *dephlegmari* vel *concentrari* dicitur.

5 Corpora, quæ vel culinari vel ſolari igne, ſive ipſa ignis vi, ſive aqua poſtea affundenda

(ut ſit in lapidibus calcareis) in Pulverem *fragilem*, *friabilem*, terræ ſimilem fatiſcunt, *calcinari* dicuntur: Pulvis iſte *Calx* appellatur præſertim ſi corpora ſint ex regno minerali deſumpta. Corpora quoque, cùm in hujuſmodi Pulverem Acidis corroſa dejiciantur, nonnunquam dici ſolent *in Calcem redigi.*

6 Corpora *via humida diſſolvi* dicuntur, cum partes eorum fluido cuivis ita adjunguntur, ut unum quaſi cum eo corpus viſu homogeneum conſtituant, in eo ſuſpenſæ maneant, nec tamen id opacum vel turbidum reddunt.

7 Corpora ſicca, quæ aeri expoſita fiunt fluida, *deliqueſcere* vel *Deliquium pati* dicuntur.

8 Fluidum, quo corpora diſſolvuntur, *Solvens* aut *Menſtruum* vocatur.

9 Menſtruum, cum de corpore ſolvendo nihil amplius in ſe recipere et ſuſtinere poteſt, *ſaturari* dicitur.

10 Separatio corporis a menſtruo quo ſolutum eſt, ſive ſpontanea ſit ſive coacta, et ſive ſurſum ſive deorſum fiat, *Præcipitatio humida* dicitur; atque Materia ad imum dejecta, vel ad ſummum evecta, *Magiſterium* vel *Præcipitatum* vocatur.

11 Cum partes corporis ſolidi adeo a ſe invicem vi ignis expandente ſeparantur ut fiant fluidæ, corpus *fuſum* vel *liquatum* eſſe dicitur.

12 Corpora heterogenea, quæ igne fuſa, diverſa particularum gravitate in duas partes interea ſeparantur, *Præcipitationem ſiccam* vel *fuſoriam* ſubire dicuntur. Pars illa quæ gravitate ſua majori imum petit, *Regulus*, altera huic ſuper incumbens *Scoria* appellatur.

13 *Eliquatio* eſt cum eo ignis gradu in quo altera Mineræ compoſitæ pars ſolida ſeu refractaria manet, altera fluit et ab illa ſeparetur.

C A P. II.

De Subſtantiis metallicis in genere.

1 SUbſtantiæ metallicæ, arte metallurgica e mineris, eductæ et fuſione purgatæ, ſunt corpora omnium longè ponderoſiſſima et (niſi ſubtilius partes dividantur) opaciſſima, aqua non ſolubilia, igne fuſilia, at calore atmoſphæræ terreſtris, (Mercurio excepto) non fluida, fulgore et nitore peculiari inſignia. Hæ in duas claſſes, alteram Metallorum, alteram Semimetallorum diſtribui ſolent.

2 Metalla, quæ hactenus cognita ſunt, ſex vulgo numerantur; Aurum, Argentum, Plumbum, Cuprum, Ferrum, et Stannum.

3 Semi-metalla habentur Platina (quæ metallis potius annumerari debeat) argentum vi-

vum, Regulus Antimonii, Biſmuthum, Zincum, Regulus Cobalti, et Nickel. Ad hæc ab omnibus fere, at temere forſan, adjungitur Regulus Arſenici.

4 Metalla a Semi-metallis majori ſua malleabilitate præcipue diſtinguuntur.

5 Metalla fere dividuntur in duos ordines, metalla perfecta ſeu nobilia, et metalla imperfecta ſeu ignobilia. *Perfecta* habentur Aurum et Argentum; quibus adjungi debet Platina. Reliqua *imperfecta* eſſe deprehenduntur.

6 *Metalla perfecta* ſunt, quæ in igne violentiſſimo et fixa manent, et calcinationem nullam patiuntur: *imperfecta*, quæ in igne et calcinationem patiuntur et partium diſſipationem.

7 Omnes ſubſtantiæ metallicæ, exceptis forſan Auro, Platina, Argento et Argento vivo, ſi in igne aperto comburantur in calces convertuntur, quæ difficilius aut facilius vitrificationem admittunt prout calcinationem magis minuſve perfectam ſubierint.

8 Calces et vitra metallica, cum Carbone, Oleo, Sevo aliiſve ſubſtantiis Phlogiſton debito ſtatu in ſe continentibus, præſertim in vaſe clauſo, igni expoſita in formam ſuam priſtinam metallicam reducuntur, modo calcinationem nimiam non perpeſſæ ſunt; ipſa operatio vocatur *Reductio.*—Annon omnes Subſtantiæ Me-

tallicæ conſtant ex terra vitreſcente et ſubſtantia inflammabili? Quod ſi Phlogiſton ſit uniforme quiddam ſibi ubicunque reperiatur ſimile, quæri poteſt 1^{mo} num terræ metallicæ ab aliis omnibus terris vitreſcentibus genere diſcrepant: et proinde, num Arte Chemica ſubſtantiæ Metallicæ generari queant: 2° utrum ſubſtantiarum Metallicarum differentia oriatur a ſpecifica quadam terrarum differentia; an a diverſa proportione et nexu quibus eadem terra cum Phlogiſto conjungitur; an ab interpoſitione aliorum quorundam corporum: et proinde poſſint necne in ſe invicem tranſmutari?

9 Subſtantiæ Metallicæ, fuſione inter ſe miſtæ, raro magnitudinem illam habent quæ oriri debeat a magnitudinibus partium componentium ſimul ſumptis. In quibuſdam vero, ut in mixtura Stanni et Cupri decrementum magnitudinis et incrementum gravitatis ſpecificæ ſunt admodum notabilia. In aliis, ut cum Stannum et Zincum una colliquantur, tantum eſt magnitudinis incrementum, ut gravitas ſpecifica ſive denſitas mixturæ minor ſit gravitate ſpecifica corporis levioris. In mixtura Cupri et Biſmuthi ea fere deprehenditur denſitas quæ ſecundum regulas communes hydroſtaticas expectari debeat.

10 Quædam ſubſtantiæ Metallicæ Ex. Gr.

Aurum, Argentum, Cuprum, Plumbum, Stannum et Zincum, igne fuſæ adeo magnitudine augeri, et ſpecifica gravitate diminui dicuntur, ut fruſtulum ſolidum ejuſdem materiæ, cuilibet earundem cum fluidæ ſint injectum, ſubmergatur et in fundum ſubſidat; ut fit in Sevo, Cera et Reſinis liquefactis: Aliæ, ut Biſmuthum Antimonium et præcipuè Ferrum, adeo diminui dicuntur magnitudine, ut ſolidum fruſtulum iis innatet, quemadmodum ſulphur ſolidum ſulphuri liquato aut Glacies aquæ innatat.

11 Plurimæ, fortaſſe omnes, Subſtantiæ Metallicæ igne ſatis fuſæ et lentius poſtea frigefactæ, partium quandam regularem diſpoſitionem vel *Cryſtalliſationem* in ſuperficie viſibilem, ſed in diverſis generibus diverſam, acquirere dicuntur.

12 Omnes Subſtantiæ Metallicæ calore dilatantur, frigore contrahuntur. Hæc magnitudinis mutatio, Pyrometro menſurata, minor eſſe obſervatur in Regulo Antimonii, et major in Zinco, quam in alia quavis Subſtantia Metallica.

13 Omnes Subſtantiæ Metallicæ citius et caleſcunt et refrigeſcunt quam aut Spiritus vini, aut Olea, aut alia ulla corpora: et hinc Thermometris et Pyrometris conficiendis adprimè aptæ ſunt.

14 Subſtantiæ Metallicæ, nec in directa nec in reciproca ratione denſitatis, cohærentiæ, duritiei, nec in ratione quavis ex his quocunque modo compoſitâ, nec denique ſecundum ullam generalem legem huc uſque repertam, calorem vel acquirunt vel amittunt.

15 Corpora Metallica fuſa omne cum ſalibus et terris etiam metallicis reſpuunt connubium, ſuperficiem convexam habent; præterquam quod ſi fuſa ſint in vaſis metallicis ab horum lateribus partes contiguæ attrahuntur quaſi, et ſuperficiei convexitas deſtruitur. Si cum ſulphure liquifiant, omnia (præter Aurum et Zincum) in mineras, iis quæ e fodinis eruuntur ſimiles, et ab iis vix diſtinguendas, convertuntur: cum Arſenico, omnia per fuſionem uniuntur, et ab eo fragilia redduntur.

16 Metalla quædam, uti Ferrum, Cuprum et Argentum, quæ ignem ut fluant fortiſſimum poſtulant, ſulphure addito citò liqueſcunt: dum alia quædam, uti Plumbum et Stannum, per ſe ſatis fuſilia, cum Sulphure conjuncta fiunt admodum refractaria.

CAP.

C A P. III.

De Argento vivo ſive Mercurio.

1 *MErcurius* eſt corpus metallicum tactu frigidum, omnium (Auro et Platina exceptis) ponderoſiſſimum; eo propemodum caloris gradu quo aqua ebullit aut etiam minori, volatile; corpora, niſi metallica, non madefaciens; Atmoſphæræ terreſtris calore fluidum.

2 Mercurius frigore artificiali, a miſtura ſpiritus nitri fumantis cum nive orto, in ſolidum mutari poteſt.

3 Mercurius frigore in ſolidum conſtr~~u~~ictus eſt metallum eximio nitore ſplendens; mallei patiens; duritie et ſono quem reddit plumbo perſimile.

4 Magnitudo Mercurii frigore fixi minor eſſe dicitur parte circiter 10^{a} quam magnitudo ejuſdem Mercurii ad ebullitionem calefacti.

5 Mercurius, cum jamjam ſit vel in calore ebulliturus, vel in frigore fluiditatem ſuam amiſſurus, celeriter aſcendere et deſcendere obſervatur.

6 Mercurius purgatiſſimus, diu multumque agitatus, converti poteſt aliqua ex parte, forſan omnis, in pollinem nigerrimum ſaporis acris,

metallici ænei, qui igne valido, nullâ re additâ, diſtillatus fit *Mercurius vivus* vel *currens.*

7 Mercurius, in igne mitiori vaſe clauſo diutius detentus, in pollinem nigrum antecedenti ſimilem mutatur: in igne fortiori digeſtus quaſi calcinatur in pulverem primo cineraceum, deinde flaveſcentem, tandem rubrum; qui impropriè vocatur, *Mercurius præcipitatus per ſe.*

8 Mercurius calcinatus vel præcipitatus per ſe, ipſo Mercurio ponderoſior eſt et in igne fixior. Adaucto nihilominus calore diſſipatur; remanente perparva quantitate pulveris fuſci, qui vitro uſtorio in vitrum fuſcum mutatur: dum mercurius qui calcinationem non paſſus eſt, ab eo calore, nullo reſtante reſiduo, in auras pellitur.

9 Mercurius quingenties amplius diſtillatus, ſingulis vicibus ſemper quiddam pulveris rubri in retorta reliquit; at aliam non ſubiit mutationem.

10 Mercurius præcipitatus per ſe, in igne culinari, nullo addito Phlogiſto, maxima ex parte reviviſcit. Reſiduum igne fortiſſimo fixum eſt: fuſum cum Borace, in maſſam friabilem vitreſcentem vertitur; cum Plumbo cupellatum, prorſus evaneſcit.

11 Acidum Nitri mercurium facile diſſolvit. Solutio evaporata, præbet Cryſtallos albas, acerrimas,

cerrimas, longas, nonnunquam et tenues nitro ſimiles: inſpiſſata, in maſſam vertitur albam, ſalinam, admodùm cauſticam, quæ æque ac cryſtalli igni in patella expoſita fit pulvis, primo albus, deinde flavus, tandem dum calidus manet purpureus, ſed frigeſcens ruberrimus; qui vocatur *Mercurius præcipitatus ruber.*

12 Acidum Vitrioli Mercurium vix diſſolvit, niſi ſit ebulliens et concentratum. Si diſtilletur, odorem ſulphureum a Mercurio acquirit, et Mercurius ſimul corroſus fit maſſa ſalina, alba, quæ in igne violentiori colorem non mutat, aere non deliqueſcit, et aquam calidam affundendo partim in ea diſſolvitur, partim mutatur in pulverem flavedinis eximiæ, qui fervida aqua ſæpius ablutus fit inſipidus; et vocatur *Mercurius emeticus flavus*, vel *Turpethum minerale.*

13 Acidum marinum in Mercurium non agit viâ humidâ; at in vapores reſolutum, et ei per ſublimationem variis modis conjunctum, ſalem cryſtallinum ſemipellucidum conſtituit; qui vocatur *Mercurius ſublimatus corroſivus*, tunc viribus rodendi maximis pollens, cùm proportio Acidi, reſpectu habito ad Mercurium, ſit maxima.

14 Mercurius ſublimatus, maximè corroſivus, cum ea quantitate Mercurii crudi tritus

quæ ſufficiat Acido marino perfectè ſaturando, et ſublimatus fit opacus, aqua non ſolubilis, vis rodentis expers, et *Mercurius dulcis ſublimatus* nuncupatur.

15 Acida vitriolica et marina iis qui Propoſitionibus 12ª et 13ª explicantur modis cum Mercurio uniuntur. Quòd ſi Acida hæc vel Solutio ſalis cujuſlibet medii, in quo alterutrum continetur, in Mercurium Acido nitri ſolutum infundantur, Mercurius ſeſe iis adjunget et pulveris albi forma præcipitabitur. Pulvis hic, ſi cum Acido vitriolico conjungatur, fit *Turpethum minerale*; ſin ab Acido marino præcipitatio fiat, *Mercurius præcipitatus albus* vocatur, ſublimato corroſivo vel dulci accedens prout ſit vel non ſit edulcoratus.

16 Mercurius ſublimatus corroſivus, aqua ſolutus, ab Alcali fixo in fundum præcipitatur in forma pulveris rubri: ab aqua calcis præcipitatus fit flavus: ab Alcali volatili albus: a miſtura Alcali fixi et Alcali volatilis paribus quantitatibus albor nihil inquinatur.

17 Spiritus vini rectificatus, et ebulliens, ſuum pene pondus Sublimati corroſivi; ad gradum 16ᵐ Thermometri Reaumeri aut 68ᵐ Fahrenheitii calefactus, tres octavas ponderis ſui partes, diſſolvit.

18 Spiritus vini rectificatus, ad gradum 68ᵐ

Thermometri Fahrenheitiani calefactus, et Sale Ammoniaco ſaturatus, Sublimati corroſivi tres quartas ponderis ſui partes diſſolvit: et proinde vis ejus ſolvendi Sublimatum corroſivum Salis Ammoniaci additione duplicatur.

19 Aqua, cum ebulliat, dimidium ſuum pondus de ſublimato corroſivo; ſi ad quinquageſimum tantùm gradum Ther. Fahren. calefiat, vix partem ſui ponderis vigeſimam, diſſolvit.

20 Aqua, Sale Ammoniaco ſaturata et ad prædictum gradum calefacta, Sublimati corroſivi duas tertias partes ponderis ſui diſſolvit: et proinde majorem habet vim ſolvendi hunc ſalem quam aqua ſimplex in proportione fere, 40 : 3.

21 Si Mercurius cum Sulphure teratur, aut cum Sulphure liquato miſceatur, pulverem fuſcum, cito in nigrum abeuntem, conſtituit; qui vocatur *Æthiops mineralis*. Hic autem ſublimatione fit maſſa rubra, friabilis, ſtriata, quæ *Cinnabaris factitia* nuncupatur; a Cinnabari nativa, quando debita ſulphuris portio adhibita fuerit, vix diſtinguenda.

22 Si Cinnabaris factitia, aut nativa, miſceatur cum Alcali fixo, Calce viva, Limatura ferri, aliiſve rebus, quibus major cum Sulphure competit affinitas, quam ipſe habet Mercurius,

et diſtilletur, *Mercurius* obtinebitur *purgatus.* Aliquid etiam Sulphuris quod ab Acidis præcipitari poteſt a cinnabari, ea cum Alcali fixo decoquenda, extrahitur.

23 Mercurius Plumbum, Stannum et Aurum facillime penetrat et friabilia reddit; et cum omnibus quidem Subſtantiis Metallicis (Nickel et Regulo Cobalti forſan exceptis) quanquam cum Ferro, Antimonio et Ære paullò difficilius, vel trituratione frigida aut calida, vel fuſione, coit, Mixtura inde proveniens vulgò *Amalgama* rectius *Malagma* dicitur: quod eſt mollius, friabilius, fluidius, aut ſpiſſius pro diverſa quantitate Mercurii in eo conficiendo adhibiti.

24 Amalgama Mercurii et Argenti: gravitatem habet ſpecificam majorem gravitate ſpecifica ipſius Mercurii.

25 Acida vegetabilia et Sales alcalini eâdem fere methodo in Mercurium, quâ in Aurum et Argentum, agunt.

CAP. IV.

De Antimonio et ejus Regulo.

1 *ANtimonium crudum*, eſt Minera a terreis et lapideis recrementis Eliquatione purgata, ſtriis nitentibus tanquam aciculis ordinatim ferè diſpoſitis diſtinctum, atque ex Sulphure et parte metallica, quæ *Regulus antimonii* appellatur, paribus plerumque quantitatibus conflatum.

2 Antimonium crudum, igne mitiori uſtulatum, album copiosè emittit fumum; quem *Florum* nomine colligere licet. Reſiduum gradatim mutatur in Calcem cineream; quæ, igne fortiori fuſa, vitrum facit hyacinthini aut fulvi coloris, durum, volatile, eò pellucidius quò perfectior fuerat Calcinatio et tenuior Liquefactio.

3 Vitrum antimonii, cum aqua regia digeſtum, colorem ei rubeſcentem impertit: Acidis vegetabilium aut Vinis infuſum, abraſione quadam ſuæ ſubſtantiæ vim ipſis emeticam conciliat; quæ tamen repetitis infuſionibus langueſcere quidem et exhauriri dicitur.

4 Vitrum Antimonii, vel Antimonium crudum, tum lapides tum metallica omnia corpora (Auro et Platina exceptis) fuſione diſſolvit,

vit, et volatilia reddit : et hinc a quibuſdam vocatur *Lupus vorax*, *Balneum Solis*, &c.

5 Vitrum vel Calx Antimonii, cum Carbone, Sapone, aliâve ſubſtantia Phlogiſton continente fuſa, reducitur in Regulum; qui, ſi partium debita fiat refrigeratio, ſtellæ ſpeciem in ſuperficie plerumque exhibet.

6 Regulus Antimonii eſt Semi-metallum durum admodum et fragile, quod a Zinco et Biſmutho tum ſpecie externâ (quâ nec cæruleſcit, ut Zincum, nec flaveſcit, ut Biſmuthum,) tum fuſilitate difficiliori diſtinguitur.

7 Regulus Antimonii, in igne aperto mitiori, fatiſcit in Calcem vitreſcentem; at in vaſis clauſis, valido igne fuſus, prorſus volatilis eſt; et Flores exhibet ſpiculorum ſplendentium inſtar, aqua ægriùs ſolubiles, igne vix volatiles, et in Regulum difficillimè reducendos.

8 *Regulus Antimonii confici poteſt*, vel Calcis reductione, ut in propoſitione 5ª explicatum eſt; vel Præcipitatione ſicca, qua nimirum interventu alterius corporis ſulphur a parte regulina ſeparatur; vel ſolutione humida partis metallicæ Antimonii crudi in Aqua Regia facta et Calcis inde dejiciendæ reductione.

9 Regulus Antimonii, cum Ferro, Stanno et Zinco fuſus, mixturas metallicas conſtituit quæ minorem habent gravitatem ſpecificam; cum

Argento, Cupro, Plumbo, et Biſmutho, quæ majorem quam ſecundum regulas communes habere debent.

10 Reguli Antimonii cum acido nitri concocti aliquid diſſolvitur, at maxima ex parte in pulverem album corroditur: ſi cum Acido vitriolico diſtilletur corroditur quoque; Acidum autem fit ſulphureum, et Sulphur ſæpe ſublimatur. In Acido marino difficulter ſolvitur, facillime in Aqua Regia.

11 Si Regulus Antimonii, vel Antimonium crudum, cum ſublimato mercurii corroſivo trituratione probè miſceatur et diſtilletur, Acidum marinum in ſublimato Mercurium deſerens, Regulo Antimonii ſeſe adjunget, et cum eo elevabitur, et in Excipulum tranſibit, vel collo Retortæ, pinguedinis glacialis aut Butyri ſpecie, adhærebit: unde *Butyrum Antimonii* nuncupatur. Aucto deinde igne, Mercurius vivus puriſſimus aſcendet, et in Recipiens decurret. Denique, ſi Antimonium crudum adhibeatur, Cinnabaris ſublimata in collo Retortæ invenietur.

12 Butyrum Antimonii aere deliqueſcit, et pulverem album deponit: repetitis diſtillationibus fit ex parte fluidum, et olei inſtar limpidum; ex parte, ſi rectè inſtituatur diſtillatio, ſublimatur cryſtallorum forma, in aere volatilium admodùm et deliqueſcentium.

13 Butyrum Antimonii, aquam affundendo, lacteſcit; et ob Acidum debilitatum, vel propterea quod Sales perfecte medii aqua vix ſunt ſolubiles, Regulus Antimonii in eo ſolutus maxima ex parte ad imum ſubſidet, ſpecie pulveris albi; qui, cum aqua ſæpius abluatur, inſipidus fiet; et vocatur *Pulvis Algaroth*, vel (impropriè licet, cum nihil inſit Mercurii) *Mercurius vitæ*; qui, ſi fuſus ſit, vitrum ſuccinei coloris evadet.

14 Liquor poſt pulveris Algaroth præcipitationem remanens Butyri aliquid in ſe retinet ſoluti, quod evaporatione cryſtallos, diſtillatione ſalem ſublimatum in collo retortæ exhibet, aere non deliqueſcentem, ſpiritu vini ſolubilem, ſali ſedativo haud abſimilem. Ipſe liquor, ſed nullo jure, nuncupatur *Spiritus vitrioli philoſophicus*.

15 Si acidum nitri a Butyro Antimonii diſtillatione ſeparetur, Aqua Regia nonnullis forſan Reguli partibus inquinata obtinebitur, quæ vulgò dicitur *Spiritus Nitri bezoardicus*, a maſſa reſidua novi ſpiritus nitri abſtractione ſubſequente calcinatione et ablutione conficitur pulvis; qui dicitur *Bezoardicum minerale*.

16 Sal Alcali fixum tùm coctione tùm fuſione ex Antimonio crudo ſulphur ejus extrahit, et ſic *Hepar Sulphuris* conſtituit; quod partem

regulinam Antimonii ſtatim diſſolvens hepar efficit Antimonii, colore hepatico vario, et aqua copioſius aut parcius ſolubile, pro diverſis proportionibus quibus Alcali fixum et Antimonium una admiſceantur. Ex Hepate Antimonii Pharmaceutici parant medicamentum quod vocant *Crocum metallorum*, nec non *Vinum antimoniale*, *Tartarum emeticum*, &c.

17 Sulphur, quod ab Hepate Antimonii aqua ſoluto per Acetum aut Acidum quodcunque præcipitetur, *Sulphur Antimonii auratum* nuncupatur. Quod vero ſpontanea præcipitatione, dum frigeſcit ſolutio, dejicitur, *Kermes mineralis* aut *Pulvis Carthuſianorum* vocatur: Utrumque a ſulphure communi diſcrepat portione Reguli Antimonii quæ in eo continetur; a ſe invicem vero diſtinguuntur, tùm proportione partis regulinæ ad partem ſulphuream, quæ minor eſt in pulvere Carthuſianorum quàm in ſulphure aurato, tùm quòd Kermes mineralis alcali aliquid fixi ſibi adjunctum retinet.

18 Si Antimonium crudum nitro commiſceatur et deflagretur, maſſa reſidua, diverſis coloribus inſignis, diverſis medendi viribus valet; atque *Crocus Antimonii medicinalis* aut *Crocus Antimonii mitior*, *Antimonii Calx diaphoretica*, &c. nominatur; pro variis proportionibus qui-

bus Nitrum et Antimonium inter ſe miſceantur. Si ea quantitas Nitri adhibeatur quæ toti Sulphuris Antimonii deflagratione deſtruendo ſatis ſit, vis maxima emetica maſſæ reſiduæ comparabitur: ſin minori aut majori proportione admiſceantur, tum aut totum Sulphuris non erit abſumptum, aut pars etiam Reguli Phlogiſto ſuo privabitur. Utroque modo mitius fit medicamentum; quippe quòd vel ad Antimonii crudi, vel ad Calcis metallicæ, vires accedat.

19 Regulus Antimonii cum Sulphure liquatus in maſſam ſtriatam crudo Antimonio ſimilem frigore concreſcet.

C A P. V.

De Biſmutho.

1 B*Iſmuthum* eſt Semi-metallum cæteris Metallicis Subſtantiis (Stanno excepto) minore ignis gradu fuſile; inter Semi-metalla (Nickel excepto) fixiſſimum; ponderoſum, fragile, ab aëre et aqua vix immutandum; Auri inſtar purum, non mineraliſatum, ſemper repertum.

2 Biſmuthum, in valido igne fuſum, fumum exſpirat inflammabilem; et, vel per ſe, vel cum

additione, ſublimari poteſt in Flores flaveſcentes: In aperto et mitiori igne, mutatur facillimè in Calcem cineream; quæ continuata flammæ reverberatione flaveſcit, at vix niſi dum calida reſtat, rubeſcet. Calx in Vitrum liqueſcit, pellucidum, fuſcum, terrarum vitrificationi et uſibus docimaſticis apprimè accomodatum.

3 Acidum Nitri Biſmuthum diſſolvit magnâ cum Efferveſcentia et vaporum eructatione. Solutio, evaporata, præbet cryſtallos albas: affuſione aquæ puræ, Biſmuthum partim in ea ſuſpenditur; partim ab ea dejicitur; et pulvis ſic dejectus vocatur *Magiſterium Biſmuthi*, *Blanc d'Eſpagne*, vel *Blanc des perles*.

4 Acidum Salis marini, cum Biſmutho coctum, parum ejuſdem diſſolvit: Acidum Vitrioli nihil, quod præcipitari poteſt; at colorem rubeſcentem ab eo extrahit.

5 Si Acidum Vitrioli in Biſmuthum fuſum infundatur, vel ab eo abſtrahatur, ſulphuris aliquid colore fuſco ſublimatur, et odor arſenici, ſentitur.

6 Acida Vegetabilia aliquid Biſmuthi, quod ab Alcali præcipitari poteſt, coctione diſſolvunt. Alcalia fixa Phlogiſto imbuta, et alcalia volatilia, in Biſmuthum eodem fere modo, quo in Argentum, agunt.

7 Biſmuthum, cum Sulphure fuſum, cum

eo coit et maſſam efformat ſtriatam, Antimonio crudo quodammodo ſimilem, et facile liqueſcentem.

8 Biſmuthum cum omnibus Metallicis Subſtantiis)Zinco et Nickel exceptis) ſeſe fuſione commiſcet et fluxiliora reddit: Stannum dealbat, durius, magis ſonorum, et fragilius ſimul efficiens.

9 Mercurius et Biſmuthum, paribus ponderibus unà fuſa, Amalgama ſolidum conſtituunt. Idem dici poteſt de Mercurio et Plumbo. At Mercurius, Plumbum, et Biſmuthum, paribus ponderibus, Amalgama efformant fluidum: ab hoc Biſmuthum, ſub ſpecie pulveris gryſei, brevi ſeparatur; at Plumbum adeò tenuiter ſolutum reſtat, ut per Corium unà cum Mercurio tranſeat.

10 Aqua ebullit gradu caloris, in Thermometro Fahrenheitiano, 212°. Biſmuthum liqueſcit gradu 460°. Stannum liqueſcit gradu 410°. At Mixtura, ex paribus quantitatibus ſtanni et biſmuthi conflata, liqueſcit gradu 280°.

11 Si Plumbum, Stannum, et Biſmuthum unà fundantur paribus ponderibus, Maſſa mixta minori dicitur liqueſcere ignis gradu quàm eo quo aqua ebullit.

C A P. VI.

De Zinco et Lapide calaminari.

1 *LAPIS Calaminaris* tertiam vel majorem ponderis ſui partem, Florum ſpecie nec ſulphur nec arſenicum redolentium, uſtulatione amittit. Si cum pulvere carbonum permiſceatur, et igne vehementiſſimo vaſis quantùm fieri poterit clauſis diſtilletur, Subſtantiam præbebit Metallicam, ex cæruleo albam; quæ *Zincum* appellatur.

2 *Zincum* eſt Semi-metallum: vel ſtriatum, ut Zincum Goſlarienſe; vel teſſellis diſtinctum, ut Indicum et Anglicanum; durum; ſonorum, malleo (dum frigidum eſt) aliquantum cedens; in pulverem trituratione non reducendum; in igne liqueſcens ſimul ac rubet, at Plumbo difficilius; ſæpius fuſum, fit (Stanni inſtar) durius, fragilius, minùs fuſile, et calcinationi minus obnoxium: ab aëre et aqua non multùm mutatur.

3 Zincum, igne leniori fuſum, mutatur in Calcem: at ſi violentior ſit ignis, inflammatur cum ſtrepitu, et odorem emittit arſenicalem; flamma lucidiſſima, viridis, ne minima fuligine inquinata, durat donec tota Zinci maſſa ſit

combuſta et in Flores albos, leviſſimos, Goſſypio ſimiles, (quos *Lanam* nuncupant *Philoſophicam)* ſublimata.

4 Zinci Flores ab Acidis omnibus diſſolvuntur; Phlogiſti additione, in vaſis clauſis *reducuntur*; in igne fixi reſtant, et in vitrum coloris praſini tandem convertuntur.

5 Acida omnia mineralia, nec non Acetum faciliori negotio Zincum quam cætera Metallica Corpora diſſolvunt: Si cum Oleo vitrioli diſtilletur Sulphur ſublimatur, Reſiduum Arſenicum olet.

6 Zincum dum, ab Acido vitriolico aquoſo, vel ab Acido marino concentrato, diſſolvitur, Aerem, vel vaporem elaſticum, fœtidum, inflammabilem copioſe emittit; at nihil Sulphuris præbet.

7 Pondus totum Aeris inflammabilis qui, per ſolutionem Zinci in Acido vitriolico generatur, æquale circiter deprehenditur parti viceſimæ-quartæ ponderis ipſius Zinci.

8 Denſitas aeris inflammabilis fere eadem eſt ex qualicunque metallo, vel qualicunque Acido ſit genitus.

9 Aer inflammabilis, per Solutionem Zinci generatus, levior eſt aere communi (Thermometro denotante gradum 50 et Barometro 30 uncias) in proportione circiter 11 : 1.

10 Zincum in Acido vitriolico ſolutum, evaporatione concreſcit in Cryſtallos, quæ vocantur *Vitriolum Album* vel *Goſlarienſe*.

11 Zincum cum omnibus Metallicis Subſtantiis (Biſmutho excepto) fuſione uniri poteſt. Paullò difficilius coit cum Ferro; facilius cum Cupro; cum reliquis facillime.

12 Zincum ab omnibus Metallicis Corporibus diſtinguitur; et ab iis depurgari poteſt: eò quòd cum Sulphure aut Hepate Sulphuris colliquefactum, nullam ab iis mutationem patitur.

CAP. VII.

De Cobalto et ejus Regulo.

1 SI Cobaltum uſtulatione in furno reverberii ab arſenico liberetur, in pulverem poſtea redigatur, et cum duplo vel triplo arenæ aut ſilicum calcinatorum et contuſorum miſceatur, mixtura aquâ irrorata in maſſam quaſi lapideam brevi indureſcit, et *Zaffera* vocatur.

2 Omnia Acida mineralia Zafferæ venalis aliquid diſſolvunt; acida vitrioli et nitri colorem fulvum aut roſeum ab ea extrahunt qui calore non mutatur; cum ab acido marino facta eſt ſolutio color ejus dùm frigida manet, eſt

fulvus aut intenſe viridis prout acidum eſt aquâ dilutum necne; at dum caleſcit ſolutio fulvus mutatur in viridem.

3 Zaffera in acido vitriolico ſoluta, forma pulveris cærulei præcipitatur ab alcali fixo phlogiſto imbuto; ſi uberior alcali copia adhibeatur præcipitatum fit e cæruleo gryſeum quod tamen affuſione ſpiritus ſalis colorem cæruleum recuperat prorſus uti evenire ſolet cum cæruleum Berolinenſe a ſolutione vitrioli viridis dejicitur.

4 Zaffera in acido vitriolico ſoluta gallarum decocto affundendo nigreſcit.

5 Zaffera ab acido quovis præcipitata, cum oleo aut ſevo miſta et igne leniter calcinata fit pulvis niger qui magneti obſequitur.

6 Zaffera igne liqueſcit in vitrum cæruleum, quod cum in pollinem ſubtiliſſimum reducitur vocatur *Smaltum* vel *Encauſtum cæruleum.*

7 Si Zaffera aut ſmaltum cum ſubſtantia inflammabili una fundantur, odor arſenicalis ſentitur, et ſubſtantia metallica in fundum præcipitatur quæ dicitur *Regulus Cobalti.*

8 Regulus Cobalti a reductione Zafferæ ab acidis præcipitatæ vel ſmalti proveniens eſt fragilis admodum et durus, coloris gryſei, texturæ lævis at non granulatæ; a magnete promptiſſime atrahitur, calcinatione mutatur in pul-

verem nigrum qui ab igne vehementiori in vitrum cæruleum, ferri inſtar, liqueſcit.

9 In Regulum Cobalti, acida vitrioli et ſalis marini vix agunt; ſolutio in acido nitri facta eſt rubra, in aqua regia viridis.

10 Regulus Cobalti per Alcali fixum commune ab aqua regia præcipitatur in pulverem rubeſcentem, per Alcali phlogiſto imbutum in pulverem cæruleum.

C A P. VIII.

De Nickel.

1 NICKEL eſt Semi-metallum ex gryſeo rubens, cæteris minus fuſile, in calcem viridem mutabile, quæ in igne etiam fortiſſimo vix liqueſcet in vitrum.

2 Si Nickel et Biſmuthum una fundantur et ſub fuſione admiſceantur, Nickel conjunctionem cum Biſmutho, prorſus aufugiens ſemper ſupernatat, et Biſmuthum in imum ſubſidet.

3 Acidum vitriolicum ſive concentratum, ſit ſive aqua dilutum Nickel non diſſolvit: Acidum marinum paullo ſegnius in illud agit; Acidum nitri cum fumorum rubrorum eructatione violenter diſſolvit, ſolutio viret, et ab Alcali volatilis affuſione fit cærulea.

4 Dum Nickel ab acido nitri diſſolvitur flocculi gryſei ab eo ſeparantur, qui in igne et ſulphuris et arſenici dant indicia.

5 Nickel ab acido nitri per alcali fixum præcipitatur in pulverem ſubviridem.

CAP. IX.

De Plumbo ſive Saturno.

1 PLumbum eſt Metallum imperfectum, minus quam cætera durum, elaſticum, tenax, et ſonorum; Stanno minus fuſile: ab actione aeris et aquæ rubiginem quandam gryſeam contrahit at difficiliùs corroditur quam Ferrum.

2 Filum Plumbi cylindricum cujus diameter decimæ parti unciæ æqualis eſt ſuſtinere poteſt pondus 29 $\frac{1}{4}$ Librarum.

3 Plumbum in igne fluit antequam candeſcit; aucto calore effumat et ebullit; fuſum in ſuperficie tegitur pelliculâ cinereâ verſicolore; quâ ſemotâ vel cum plumbo mixtâ, altera enaſcitur; et ſic tandem tota maſſa in Calcem converti poteſt quæ vocatur *Plumbum uſtum.* Hoc autem, Plumbo in hunc finem adhibito, levius eſt.

4 Plumbum uſtum ſi ſubitam ignis violenti

actionem patiatur, fit Olei inſtar fluidum, et in Scoriam convertitur vitreſcentem, ex ſquamoſis lamellis, flaveſcentibus aut rubeſcentibus, pro diverſo ignis gradu, conſtantem et *Lithargyrus* vocatur. Lithargyrus æquè ac Plumbum uſtum in igne mitiori diutiùs detentus, flammâ ſimul in ſuperficiem ejus ſupernè reverberatâ, fit primo flavus, deinde aureus et Gallico idiomate a Pictoribus dicitur *Maſſicot*; tandem ruber, et vocatur *Minium.*

5 Maſſicot in igne calefactus fit e flavo ruber, frigeſcens iterum fit flavus.

6 Plumbum in Minium converſum licèt multum de ſubſtantiâ ſuâ Florum formâ deperdat, pondere pluſquam decimâ parte augetur; at Minium illud nihilominùs, *Reductione factâ*, pondus æquale ponderi Plumbi ex quo erat confectum minimè præbebit.

7 Lithargyrus, Maſſicot, Minium aliæve Plumbi Calces facilè liqueſcunt in Vitrum coloris aurei.

8 Lithargyrus vel Vitrum Plumbi cum lapidibus, vel terris quibuſcunque refractariis fuſus, mirificè earum liquefactionem promovet; et Metallica corpora (Auro, Platinâ et Argento exceptis) in Scoriam vel Vitrum ſecum rapit; et hinc commodè adhibetur tùm ad Vitra conficienda pellucidiſſima, tùm ad Metalla perfecta

a Mineris et Metallicis imperfectis purganda.

9 Plumbum ab Acido Nitri aquâ diluto copiosè diſſolvitur. Solutio evaporata in Cryſtallos concreſcit, albas, pyramidales, ſapore dulces, auſteras; quæ in vaſe clauſo igni expoſitæ crepitant at non inflammantur.

10 Plumbum in Acido Nitri ſolutum, inde præcipitatur ab Acidis tum Vitrioli tum Salis marini quibus ſeſe conjunget: cum Acido marino ſic conjunctum Plumbum quod corneum vocant, cum Acido Vitrioli, Vitriolum Plumbi conſtituit.

11 Si Plumbum ſit cum Acido Vitriolico concoctum aliquanta ex parte diſſolvitur; Diſtillatione in vaſis clauſis inſtitutâ, totum corroditur in maſſam albam aquâ ex parte ſolubilem; vapor Sulphureus, qui inflammationem nonnunquam admittit, ſub fine exit et Sulphur ſimul ſublimatur.

12 Si in Plumbum fuſum Acidum Vitriolicum infundatur, Sulphur communi prorſus ſimile ſtatim ſublimatur.

13 Si Plumbum ſit cum Acido marino coctum exigua ejus pars ab Acido diſſolvitur. Solutio, debitâ factâ evaporatione, Cryſtallos ſiſtit, albas, pellucidas, Nitro haud abſimiles; vel cum adhuc calida ſit in aquam frigidam infuſa, præcipitatum præbet eximie album.

14 Acetum longâ digeſtione parum Plumbi diſſolvit; at in vapores reſolutum illud rodit in rubiginem ſquamoſam, friabilem, inſipidam, inodoram, quæ vocatur *Ceruſa alba.*

15 Ceruſa alba, vel Lithargyrus vel Minium ſi cum Aceto coquatur ab eo diſſolvitur. Quælibet, harum ſolutionum uſque ad Mellis ferè craſitiem evaporata, Salem præbet cryſtallinum, dulcem, ſtipticum, venenoſum, dictum *Saccharum Saturni.* Quod diſtillatione ſpiritum ardentem præbet.

16 Olea Vegetabilium ſive Stillatitia ſive preſſa Plumbum integrum vel Calces ejus quaſlibet, (copioſiùs autem Minium) in coctione diſſolvunt. Solutiones ab Aceto poſſunt decomponi: et Olea preſſa ſic a Plumbo liberata Spiritu Vini fiunt ſolubilia.

17 Alcalia fixa per Calcem vivam acuata, parum Plumbi diſſolvunt, multum rodunt.

18 Si Calx quælibet Plumbi vel Plumbum integrum cùm Sulphure liquefiat, in Mineram, igne vix fuſibilem at naturali Plumbi Mineræ ſpecie perſimilem mutabitur. Plumbum cum Arſenico fuſum in Flores partim ſublimatur, partim in Vitrum hyacinthinum mutatur.

19 Plumbum cum omnibus ſubſtantiis Metallicis (Ferro excepto) per fuſionem commiſceri poteſt.

20 Si Mixtura Metallica ex Plumbo et Stanno confecta ſit fuſa cum ferro, Stannum (connubium Plumbi reſpuens) ſeſe Ferro adjunget.

21 Si Mixtura Metallica ex Ferro et Cupro vel ex Ferro et Argento conflata, ſit fuſa cum Plumbo, Cuprum vel Argentum Ferrum deſeret, et cum Plumbo in maſſam coibit.

22 Si Mixtura Metallica ex Plumbo et Stanno confecta ſit fuſa cum mixturâ ex Ferro et Argento conflatâ Stannum (Plumbum deſerens) ſeſe Ferro adjunget; et Plumbum ſimul Argenti connubium petit, et maſſas (utcunque ſub fuſione agitantur) diſtinctas, cum frigeſcunt, ſemper exhibebunt.

23 Plumbum ſcriptorium ſive Molibdæna, igne violentiſſimo occluſo, ferè nihil; igne aperto decimam quartam partem ponderis amittit. Reſiduum ne particulam præbet Plumbi at Ferri Magneti obedientis multum.

24 Plumbum ſcriptorium, in pollinem comminutum, cum Sulphure liquato intime coit et maſſam vix a verâ Minerâ diſtinguendam conſtituit; niſi quòd in flammâ candelæ accenditur et fumum Sulphureum exſpirat.

C A P. X.

De Cupro ſive Venere.

1 *CUPRUM* eſt Metallum imperfectum; Auro, Argento, Plumbo et Stanno magis durum et elaſticum, at in igne minus fuſile; Plumbo et Stanno magis ductile et fixum: et omnium maximè ſonorum.

2 Cuprum, diu candeſcens, tandem fluit; fuſum, fit humidi admodum impatiens; in aperto igne violentiori ſi detineatur, Pondus ejus diminuitur, Superficies comburitur et in Crocum ſubrubrum convertitur, qui ab igne ſolari denſato vitrum fit rubrum.

3 Ea eſt *Cupri tenacitas* ut filum cylindricum, cujus diameter æqualis eſt decimæ parti unciæ ſuſtineat pondo $299\frac{1}{4}$.

4 Cuprum ab omnibus Acidis, tùm mineralibus tùm vègetabilibus, diſſolvitur, nec non ab Alcali fixo et volatili, a Salibus mediis, Oleis expreſſis et eſſentialibus; ab ipſis Aere et Aquâ eroditur et in Æruginem mutatur: frictu calefactum, odorem; manducatum, ſaporem nauſeam moventem præbet.

5 Cuprum ab Acido Nitri facillimè diſſolvitur; ab Acido marino difficiliùs, ab Acido vi-

triolico difficillimè, niſi acidum ſit concentratum et ebulliens. Hæc Solutio cryſtallos dat, cæruleas, figura rhomboidales, in aere non deliqueſcentes, quæque *Vitriolum* conſtituunt quod a Mercatoribus *Romanum* aut *Cyprium*, vel *Cuperoſum cæruleum* vocatur.

6 Ab aquis cæmentatoriis ut vocantur vel, quod eodem redit, a vitriolo cæruleo in aquâ ſoluto Cuprum puriſſimum præcipitatur additione ferri. Solutio vireſcit, acido ferrum ſubeunte.

7 Si Cupri lamellæ ſint alternatìm ſtratæ cum vinaceis exſiccatis (quæ cum vino generoſo per fermentationem in acetum abeunte aliquot dies priùs fuerint digeſtæ) erodentur, et ſuperficies ſingularum viridi-cærulea quadam cooperietur effloreſcentia, quæ *Ærugo* vel *Viride Æris* nuncupatur.

8 Cuprum vel Viride Æris venale (quod conſtat ex Cupro et Acido in proportione circiter 5 : 7.) ab aceto ſtillatitio ſolutum, dat per inſpiſſationem cryſtallos virides, aëre ſicco in pulverem fatiſcentes, quæ apud Mercatores impropriè dicuntur *Viride Æris diſtillatum.*

9 Viride Æris diſtillatum, dimidium penè ſui ponderis, Acidi admodum concentrati diſtillatione præbet, quod *Acetum radicatum* vel *Spiritus Veneris* vocatur.

10 Spiritus Veneris eſt aliquantùm volatilis, odorem exhalat ſuffocantem; igne Spiritus quemadmodum Vini, eſt inflammabilis; cryſtalliſationem admittit; et *Ætherem acetoſum* diſtillatione cum Spiritu Vini exhibet.

11 Reſiduum ex Spiritu Veneris præparatione in Cuprum reducitur per ſimplicem cum Borace fuſionem.

12 Si Cupri limatura et Sublimatum Mercurii corroſivum unà diſtillentur, Acidum marinum Cuprum invadens, illud in maſſam reſinæ citrinæ vel rubræ ſimilem mutabit.

13 Cuprum ab Oleis vel Spiritu Vini ſolutum, vel in integro etiam ſuo ſtatu igne utcunque combuſtum, colorem viridem flammæ impertit.

14 Cuprum calcinatum, præcipitatum, ſulphuratum, qualicunque demum modo paratum, vel etiam integrum vitro miſtum et ſine additione fuſum, colore viridi vitrum imbuit.

15 Si Cuprum ſit cum Lapide Calaminari aliâve Zinci Minerâ, debitâ adhibitâ encheireſi colliquefactum, pondere, ad tertiam vel majorem ponderis totius partem, augebitur. Mixtura Metallica flava conflabitur, quæ *Aurichalcum* vocatur.

16 Aurichalcum frigeſcens Cupri malleabilitatem habet; igne calefactum ſit fragile; ſed

levius, durius, fuſilius, magis ſonorum, ſcorificationi in igne mitiori, actioni aëris et aquæ ipſo Cupro minus obnoxium deprehenditur.

17 Aurichalcum in igne diutius fuſum mutatur in Cuprum; quippe Zincum ſive pars metallica Lapidis Calaminaris comburendo diſſipatur.

18 Aurichalcum, cum Mercurio trituratione amalgamatum, mutatur in Zincum: quippe Cuprum, reſtante Zinco, Mercurio adjungitur.

19 Cuprum, cum Zinco liquatum in proportione 4 : 1. vel ſecundum alias proportiones, Mixturas varias Metallicas conſtituit, colore Auro perquam ſimiles, at propter Zinci impuritatem plerumque fragiles; quæ vocantur *Metalla Principis Ruperti*, *Metalla aurea ſophiſtica*, *Metalla Tombacina*, &c.

20 *Cuprum album* conficitur ex Cupro colliquefacto cum Arſenico per Nitrum fixo. Sæpiùs fuſum pondere diminuitur parte circitèr ſeptimâ, in Cuprum rubrum mutatur et ſub fuſione odorem efflat arſenicalem.

21 Si Cuprum et Stannum, quibus pauxillum Aurichalchi aut Biſmuthi nonnunquam adjicitur, per fuſionem commiſceantur, Mixturam Metallicam conſtituent ſubflavam, duram, ſonoram, fragilem, Aeris et Aquæ actioni ipſo Cupro longe difficilius cedentem; quæ vo-

catur *Metallum tormentorum bellicorum, Campanarum, Æs Caldarium, Bronze,* &c. pro varia proportione quibus Cuprum et Stannum unà liquantur.

22 Si æquales magnitudines Cupri et Stanni unà fundantur, Mixtura ex his conflata minor erit, parte pluſquam quarta, quam cuprum et ſtannum ſimul ſumpta; pondus tamen haud mutabitur et gravitas ſpecifica fiet ipſâ Cupri gravitate ſpecificâ major.

CAP. XI.

De Ferro ſive Marte.

1 *FERRUM* eſt Metallum imperfectiſſimum; aëri et aquæ expoſitum, omnium facillime rubigine exeditur; cæteris, (Platinâ exceptâ) minùs fuſile, et (excepto Cupro) magis ſonorum; duritie et elaſticitate omnia exſuperat; et unicum eſt quod a Magnete attrahitur.

2 Ferri Filum cylindricum, cujus Diameter decimæ parti Unciæ equalis eſt, ſuſtinere poteſt pondus 450 Librarum. Hinc Ferrum videtur omnium Metallorum eſſe tenaciſſimum. Nam tenacitas non videtur eſſe menſuranda ponderibus quibus diſrumpantur fila metallica ea-

rumdem Diametrorum, ut aſſolet, ſed quibus cohæſio datarum Quantitatum materiæ ſuperatur; vel ponderibus, quibus fila, cujus Diametri ſunt in reciprocâ ſubduplicatâ ratione gravitatum ſpecificarum, diſrumpuntur.

3 Ferrum, violentiori motu attritum, candeſcit; igni fortiori expoſitum, in ſuperficie quodammodo vitreſcit; ad fuſionem accedens ſcintillat, fumum vel flammam quaſi Sulphuream emittit, et in calcem mutatur: at in clauſo vaſe Calcinationem non patitur.

4 Si Ferrum excandeſcens follium continuo flatu urgeatur, Calor ejus augebitur et liqueſcet.

5 Ferrum ab Acido vitriolico aquoſo facillimè diſſolvitur. Solutio hæc evaporata Salem præbet, viridem, rhomboidalem, qui vocatur *Sal Martis*, *vitriolum* vel *Cuperoſum viride*.

6 Ferrum duriſſimum, ſub aqua vitriolica per plures Annos ſubmerſum, fit, ut dicitur, mollitie et Colore Molibdenæ perſimile.

7 Acidum nitroſum agit violentèr in Ferrum; marinum paullò ſegniùs; utrumque cum eo Salem deliqueſcentem efficit; qui, cùm Acidum marinum adhibetur, in Spiritu Vini eſt maximâ ex parte ſolubilis.

8 Acida omnia Vegetabilia, tùm nativa tum fermentatione generata, nec non Sal Ammoniacus,

acus, Sales Alcalini, Aqua, et Aer, agunt in Ferrum et varia inde Pharmaceuticis ſuppeditantur medicamenta. Horum præcipua ſunt 1° *Croci martiales* vel *Calces Ferri*, colore rubro aut flaveſcente tinctæ, ſive parantur Calcinatione, Præcipitatione, vel ſimplici Actione Aquæ, vel Aquæ et Aeris conjuncta. 2° *Tincturæ martiales*, vel Ferrum variis modis in Spiritu Vini ſolutum. 3° *Flores martiales*, vel Ferrum cum Sale Ammoniaco ſublimatum. 4° *Lixivium Martis*, vel Reſiduum a Sublimatione Ferri cum Sale Ammoniaco quod in liquorem deliquio redactum eſt. 5° *Vinum Chalybeatum*, vel Ferrum in vino Rhenano digeſtione ſolutum. 6° *Rotuli martiales*, et *Tartarus Chalybeatus*, vel Ferrum cum Tartaro conjunctum, &c.

9 Limatura ferri aquâ madefacta ſæpius et exſiccata, in Rubiginem tota convertitur, pondere augetur, et *Salem volatilem*, ut dicitur, diſtillatione exhibet.

10 Cum Ferrum in Acido vitriolico vel marino diſſolvitur, vapor elaſticus, fœtens, ſulphureus generatur; qui admotione Candelæ inflammatur.

11 Si partes æquales Scobis ferreæ et Sulphuris vulgaris in mortario triturentur, et in paſtam aqua formentur, Mixtura, paucis elap-

ſis horis, incaleſcit, turgeſcit, vaporem ſulphureum exspirat, et ſi quantitas ſit ſatis magna, flammam ſponte concipit.

12 Ferrum candens cum Sulphure facillimè coit, et ab eo reducitur in Speciem Mineræ aere efflorescentis, Pyritæ martiali effloreſcenti perſimilis.

13 Ferrum, uberiori Phlogiſto imbutum, mutatur in *Chalybem.*

14 Chalybs, Phlogiſto ſuperabundanti privatus, mutatur in ferrum. Quæ^{r}? Utrum Phlogiſton ſit unicum Principium, ex cujus majore vel minore copiâ pendet inter Ferrum et Chalybem diſcrimen?

15 Chalybs, igne calefactus et aqua frigida ſubitò immerſus, fit durus admodum et fragilis; et ſic a ferro diſtinguitur, æquè ac majori ſuâ gravitate ſpecificâ, fuſilitate in igne faciliore, elaſticitate majori, Colore magis nigricante, et textura magis compacta, quæ ex granis exiguis, diverſarum in diverſis Generibus magnitudinum conſtat.

16 Chalybs expolitus, per diverſam ignis actionem, diverſos exhibet Colores. Primò flaveſcit, deinde flavet, rubeſcit, purpuraſcit, liveſcit, nigreſcit, tandem aucto adhuc igne candeſcit.

17 Chalybs, igne candefactus, et immerſione in aquam induratus, duritiem ſuam gradatim

tim amittit dum colores diverſos prædictos ſuſcipit; et ex hac coloris mutatione de duritie inſtrumentorum quæ ſingulis operibus conveniat judicium ferunt opifices.

18 Ferrum in Acidis ſolutum adfuſione decocti Gallarum (ſi ſolutio ſaturetur) nigreſcit, et lente in fundum ſubſidet, ſpecie nigri pulveris; qui ab acido maximâ ex parte iterum diſſolvi poteſt.

19 Ferrum in Acido vitriolico ſolutum, inde præcipitari poteſt Alcali fixo quod phlogiſto qualicumque ſaturetur idque ſub formâ pulveris cærulei; qui a pictoribus nuncupatur *Cæruleum Bærolinenſe.*

20 In Cæruleum Bærolinenſe Acida non agunt: Alcalia fixa materiam colorantem ab eo extrahunt, et eâ ſaturari poſſint.

21 Alcalia fixa, cum Materia colorante Cærulei Bærolinenſis ſaturata, cum Acidis non efferveſcunt; colorem Cæruleum Vegetabilium non virideſcunt; et Ferrum, in Acido quocunque ſolutum, ſub cæruleo colore præcipitant.

22 In omni ferè Arenâ, in Argillis coloratis, in Lapide Lazuli, in pleriſque lapidibus pretioſis, in cunctorum ferè Vegetabilium cineribus, in Craſſamento ſanguinis, in Urinâ, et in carne Animalium, in cineres redactis,

vel etiam leni calore exſiccatis, particulæ plurimæ reperiuntur quæ a Magnete attrahuntur.

23 In Oſſibus Animalium, in pinguedine, et parte ſanguinis ſeroſâ, calcinatis, vel nullæ vel perpaucæ deprehenduntur particulæ Magneti obſequentes.

24 Particulæ quæ Magnetis Vim patiuntur plures reperiuntur in ſanguine Hominum et Quadrupedum, quàm in Sanguine Piſcium; et plures in Sanguine Piſcium quam Volatilium: et, in genere, quò uberior ſit Globulorum rubrorum in ſanguine innatantium copia, eò major deprehenditur quantitas particularum, Magnetis actioni obedientium.

25 Particulæ, a cineribus magnete ſeparatæ, Acidis diſſolvi nequeunt.

26 Ferrum, cum Plumbo fuſum, omne cum eo reſpuit conſortium, et ei perpetuo ſupernatat: at aliis Metallicis Subſtantiis (zinco forſan, quod calorem debitum ſuſtinere nequeat, excepto) facile per fuſionem coit, et Mixturas varias Metallicas conſtituit: Hæ autem, ſi ejus cum Regulo Antimonii (ob Sulphur forſan, quo Regulus inquinatur) mixturam excipias, Magnetis attractionem patiuntur.

27 Ferrum cum Mercurio vix amalgamari poteſt, at ſub eo nihilominus per aliquot Dies

ſubmerſum, vel vapori Mercuriali expoſitum ſit, ut dicitur, fragile et friabile.

28 Ferrum materia vitreſcente per fuſionem mixtum, minore ignis gradu viridem, majore cæruleum ei ſemper impertit colorem.

C A P. XII.

De Stanno ſive Jove.

1 STANNUM eſt metallum imperfectum, præ cæteris metallis levius et in igne fuſilius; at Plumbo excepto, minima duritie, tenacitate, elaſticitate, ſono gaudens: Stridor quidam inter plicandum, ei, Zincum ſi excipias, eſt proprius; aëris et aquæ actioni parum profecto cedit.

2 Stanni filum cylindricum cujus diameter decimæ parti unciæ æqualis eſt ſuſtinere poteſt pondus 49 Librarum.

3 Stannum uſque fere ad fuſionem calefactum, vel poſt fuſionem frigeſcens et in ſolidum tantum non condenſatum, fit rigidum admodum et fragile, et ſi motu velociori in eo ſtatu conquaſſetur in granula minuta, poroſa erit divulſum. Plumbum et Aurichalchum ſimilem ſubeant comminutionem, at Aurum et Argentum quæ fuſioni proxima fiunt tenaciora,

ra, Granulationem ea methodo non admittunt.

4 Stannum fuſum odorem exſpirat arſenicalem, ſcintillas emittit, et in calcem albeſcentem, difficillime reducendam, et in foco etiam ſpeculi uſtorii vix vitrificandam, citò calcinatur.

5 Stannum in igne fortiſſimo diutius detentum dicitur partim in flores ſublimari, partim in calcem rubeſcentem redigi, partim in vitrum pellucidum coloris rubei mutari.

6 Stannum et Plumbum una fuſa turgeſcunt, et lucida quaſi combuſtione citius in cineres exuruntur, quam ſingula ſeorſim calcinata.

7 Si Calces ſtanni et plumbi cum ſilice calcinato vel vitro pellucidiſſimo contuſo et ſale alcalino fixo ſimul fundantur, maſſam vitreſcentem lacteam in arte fictili et encauſtica utiliſſimam conſtituent; cui ſi calces aliorum metallorum conjungantur, encauſta varia diverſimode colorata conficientur.

8 Si ſtannum cum Acido vitriolico concentrato uſque ad ſiccitatem in vaſis clauſis diſtilletur, multum exibit vaporis ſulphurei qui inflammationem nonnunquam admittit, et ſulphur ſimul in collo retortæ ſublimatum invenietur. Quod ſi acidum ſit aqua dilutum vapor eſt ſemper fere inflammabilis, et ſulphur

præcedente

præcedente ut videtur, minus flavum et in minori copia generatur.

9 Stannum in acido vitriolico aquoſo copioſe diſſolvitur; ſolutio, debitâ factâ evaporatione cryſtallos præbet albas, tenues lanugini ſimiles quas *Vitriolum Jovis* nominare liceat.

10 Stannum ab acido marino calefacto et concentrato promptius diſſolvitur, et vapor inde inflammabilis ſulphur et Arſenicum redolens producitur, cujus pondus æquale circiter deprehenditur parti quadrageſimæ quartæ ponderis Stanni ſoluti.

11 Si Stannum cum Sublimato mercurii corroſivo diſtilletur, primo in excipulum cadent guttulæ quædam acidi marini, deinde prodibit liquor eximiè fumans, qui *Liquor fumans Libavii* dicitur, (in æthere marino conficiendo utiliſſimus) tandem in collum retortæ ſtannum cum acido marino conjunctum ſub forma ſolida elevabitur.

12 Stannum ab acido nitri promptiſſime diſſolvitur, vel potius ni cautè inſtituatur ſolutio in calcem corroditur: Ab aqua regia ſolutio ejus facillime abſolvitur; hæc ſolutio eſt coloris et ſpiſſitudinis variæ, haud raro in ſolidum, juris inſtar gelati, concreſcit.

13 Stannum in aqua regia ſolutum, ſub leni

evaporatione arſenici plerumque cryſtallos exhibet: quod ab imperfecta mineræ calcinatione provenire cenſendum eſt, cum datur ſtannum ab omni arſenico immune.

14 Stannum in acido nitri vel in aqua regia ſolutum, et cum purpuraſcentibus decoctionibus Ligni Braſiliani, Cochinellæ, &c. mixtum, colores earum in uſus tinctiles eximie exaltat.

15 Si Stannum, argentum vivum, ſulphur, et ſal ammoniacus accuratè admiſceantur, ac in igne forti ſublimentur, ſuperiora vaſorum petet quædam Cinnabaris, in imo remanebit maſſa levis, friabilis, coloris aurei, quæ vocatur *Aurum Muſivum* vel *Muſicum*, quod phlogiſti additione in ſtannum reducatur.

16 Stannum in Aceto, vino Rhenano, et ſuccis nativis acidis vegetabilium diſſolvi poteſt.

17 Stannum cum omnibus metallicis corporibus facillime fuſione commiſceri poteſt; fragilia (ob arſenicum forſan quo inquinatur) reddit, et difficillime ab iis ſeparatur.

17 Stannum cum plumbo colliquatum fit rigidius; fuſum cum Biſmutho, Zinco, Regulo Antimonii, &c. fit magis durum, album, et ſonorum.

18 Stannum foliatum cum mercurio facillime in Amalgama coit, quo ſuperficies poſteriores ſpeculorum planorum obduci ſolent.

19 Si Stannum, Plumbum, et Biſmuthum una fundantur, et cum Mercurio commiſceantur, Amalgama conſtituent ad ſuperficies concavas obtegendas apprime idoneum.

20 Stannum fuſum cupri et ferri non tantum ſuperficiei adhæreſcit, ſed in intimiora penetrat, ut videre licet in ferreis inſtrumentis quibus opifices utuntur ad laminas ferreas ſtanno illinendas.

C A P. XIII.

De Argento ſive Lunâ.

1 *ARgentum* eſt Metallum perfectum; ductilitate et fixitate Auro proximum; fluit cum primùm candeſcit, et paullo facilius quam Ferrum, Cuprum et Aurum: Aurum, Plumbum et Stannum duritie et elaſticitate ſuperat; omnibus Metallis, (Cupro exceptó) magis ſonorum eſt; actione aëris et aquæ prorſus immutabile, at a Sulphureorum halitu infuſcatur.

2 Argentum, ut ait Kunckelius, igni vehementiſſimo furni vitriarii per menſem expoſitum, 64^a circiter ponderis parte diminutum deprehendebatur; ſpatio duorum menſium, ut ait Gaſtus Clavius, decrementum ponderis in eodem igne patiebatur æquale parti duodecimæ

ponderis totius; ut ait Hombergius, vitro uſtorio expoſitum in fumum abiit, ſed in Vitrum non fuit converſum.—Annon ponderum decrementa ignobili alicui Metallo quod cum Argento miſceatur, potius quam defectui fixitatis in Argento ipſo, attribui debeant?—Annon fumus, quem obſervavit Hombergius, ipſi Argento in Auras acto, potius quam Argento in partes diſſimiles reſoluto, referendus eſt?

3 Ea eſt *Argenti tenacitas*, ut filum Cylindricum, cujus Diameter æqualis eſt decimæ parti Unciæ, ſuſtinere poteſt, pondus 270 Librarum.

4 Argentum non ſolvitur in Acido Salis marini, viâ humidâ, nec in Aquâ regiâ; difficillimè quidem in Oleo Vitrioli, etiam ebulliente; promptiſſimè verò in Acido Nitri ſolvitur. Solutio in Acido Nitri facta, ſi depuratum ſit Argentum, eſt pellucida, excolor, amara, cauſtica.

5 Solutio Argenti, in Acido Nitri facta, Capillos, Cutem, Oſſa, cæteraque Animalium ſolida, nec non Achatem, Jaſpidem, pluresque alios lapides fuſco vel nigro colore tingit: evaporatione in Cryſtallos concreſcit albas, quæ in igne fuſæ colorem induunt nigrum et maſſam cauſticam conſtituunt quæ vulgò dicitur, *Luna cauſtica* vel *Lapis infernalis*; quæ vi minori, aut majori, cauſticâ pollet, prout Solutio eſt penitus, vel ex parte, ſaturata.

6 Argentum, ex ſolutione ſuâ in Acido Nitri præcipitatum, fit ſolubile, per Acidum vegetabile, vel nativum, vel ex fermentatione generatum: per Alcali volatile et Alcali fixum, quod conficitur calcinando Sale alcalino fixo, cum ſanguine bovino: ſed nec per Alcali fixum commune, vel cauſticum, vel Calcinatione cum Carbone vegetabili paratum, nec per Nitrum fixum detonatione cum carbone vegetabili aut animali. Hoc autem defectui ſalis alcalini volatilis quo alcali fixum ſanguine bovino calcinatum imbuitur, attribui forſan poteſt.

7 Si in Solutionem Argenti Acido Nitri factam, infundatur Acidum Vitrioli, vel Salis marini, vel Solutio cujuſlibet Salis, hoc vel illud Acidum continentis, Argentum deſer~~i~~et Acidum Nitri, et cum Acido vitrioli vel Salis marini conjunctum, Coaguli inſtar albi, in fundum ſubſidet.

8 Argentum, cum Acido marino conjunctum et igne fuſum, fit Corpus admodum volatile; ex parte pellucidum et quaſi corneum; et exindè *Luna cornea* appellatur: quæ in aquâ vix ſolvitur, et quinta circiter parte, accretione Acidi, Argento ſoluto ponderoſior eſt.

9 Si Argentum ſit cum Acido vitriolico uſque ad ſiccitatem diſtillatum, vapor prodit ſulphureus, at nihil ſulphuris ſublimari obſervatur;

tur; ipſum Argentum in maſſam duram flaveſcentem, aquâ maximâ ex parte ſolubilem, et Cryſtalliſationis capacem convertitur.

10 Si in Argentum fuſum Acidum vitriolicum infundatur, vapor prodit eximie ſulphureus; at Sulphur non ſeparatur.

11 Argentum ab omnibus Metallicis Subſtantiis (Auro et Platinâ, et perparvâ forſan Cupri Quantitate exceptis) Cupellatione liberatur. In Acido Nitri ſolutum, et inde ab Acido marino præcipitatum, fit reductione factâ, ab omni Corpore heterogeneo immune et puriſſimum habetur.

12 Argentum, cum Sulphure fuſum, in Maſſam fragilem convertitur; colore et mollitie plumbi ſimilem. Hâc fuſione minima pars Auri a Maſſâ quâlibet Argenti ſeparari poteſt.

13 Argentum, cum Cupro Colliquifactione conjunctum, fit magis durum et ſonorum. Quod ſi cum Stanno vel Regulo Antimonii conjungatur, pene omnem ſuam Malleabilitatem perdit.

14 Argentum purum ponitur æquale duodecim denariis. Si ejus pars duodecima ſit Cuprum, vel aliud imperfectum metallum, dicitur conſtare ex undecim denariis; quale eſt Argentum ex quo *Ludovici* cuduntur. Argentum Anglice dictum *Sterling* conſtat ex unde-

cim denariis, unâ cum decimâ denarii parte; ſive Cuprum eſt ad Argentum ut 3 : 37, in Monetâ noſtrâ.

15 Argentum vel ſulphuratum, vel præcipitatum vel integrum, cum Vitro cryſtallino fuſione intime mixtum, vel Cæmentatione utcunque conjunctum, colorem flavum ei ſemper impertit.

CAP. XIV.

De Auro ſive Sole.

1 AURUM eſt Metallum perfectiſſimum, coloris inter fulvum et ſubflavum varii; cæteris metallis, plumbo et ſtanno exceptis minus elaſticum, durum, et ſonorum; plumbo, ſtanno, et argento minus fuſile; fixitate, pondere, et ductili extenſione omnia exſuperans; actione aëris et aquæ immutabile.

2 Aurum in igne vehementiſſimo furni vitriarii per plures hebdomadas liquefactum, nullam aut calcinationem aut partium diſſipationem patitur: ab igne ſolari condenſato, in auras diſſipatur, at nec in vitrum violacei coloris nec in partes diſſimiles, ab illo etiam ignis gradu, converti videtur.

3 Aurum in igne candeſcens funditur, fu-

ſum colorem cæruleo-viridem induit, cæteris metallis mole magis augeri videtur; non ſatis fuſum vel ſubito nimis refrigeratum, fit malleo paullò intractabilius, at a carbonum vaporibus fragile non redditur.

4 Auri filum cylindricum cujus diameter decimæ parti unciæ æqualis eſt ſuſtinere poteſt pondo 500.

5 Aurum cum Borace fuſum, fit ſolito pallidius, refuſum cum nitro colorem ſuum recuperat.

6 Poſito quod gravitas ſpecifica aquæ diſtillatæ et ad gradum 53^m^ Therm. Fahren^i^. calefactæ ſit 1,000, gravitas ſpecifica auri purgatiſſimi haberi poteſt 19,376.

7 Auri reliquorumque metallorum etiam puriſſimorum gravitates ſpecificæ intra certos limites variæ erunt, propter et diverſam gravitatem abſolutam, et diverſam expanſionem aquæ, quâ in diverſis locis et diversâ cæli temperie ponderantur.

8 Aurum cum omnibus ſubſtantiis metallicis per fuſionem commiſceatur.

9 Mixtura auri et ferri in minori fluit ignis gradu, quam ferrum ipſum, et inde fit idonea ad ferri fracturas ferruminandas.

10 Mixtura auri et cupri fuſilior eſt quam aut aurum aut cuprum, et inde utrique fit idoneum ferrumen.

11 Aurum cum Subſtantia quacunque Metallica colliquatum fit minus ductile; ab Argento et Cupro malleabilitas ejus minimè diminuitur, maxime autem vel potius aufertur perparvis quantitatibus Plumbi aut Stanni, vel etiam ſi vaporibus ſolum, quos fuſa emittunt, bilance non dignoſcendis ſit expoſitum.

12 Aurum ut moneta fiat, atque ut aliis uſibus Oeconomicis inſerviat, durius reddi ſolet mixturâ parvarum quantitatum aliorum metallorum Argenti præcipue et Cupri, vel amborum conjunctim.

13 Maſſa quælibet auri in partes viginti quatuor, quas Ceratia vocant, dividi ſemper concipitur; et dicitur Aurum obryzum; Aurum caraticum tria et vicenarium, ut Aurum Ducatorum; Aurum caraticum duo et vicenarium, ut Aurum in Anglia dictum *Standard*, et ſic deinceps, prout Aurum ſit ab omni mixtura heterogenea illibatum, vel una, duabus, et ſic deinceps partibus vigeſimis quartis alterius alicujus metalli inquinatum.

14 Aurum, in integro ſuo et naturali ſtatu, hucuſque ſolubile non deprehenditur ab ullo acido ſimplici, ſulphure, alcali fixo vel volatili: ſed ab aqua regia, et hepate ſulphuris diſſolvi poteſt.

15 Aurum cum Argento colliquatum, ab

acido marino, debita ſi adhibeatur Encheireſis, diſſolvi dicitur.

16 Aurum in aqua regia ſolutum, et ex inde per Alcali fixum præcipitatum, ab omnibus acidis tum mineralibus tum vegetabilibus diſſolvi poteſt, nec non a ſale Alcalino volatili, et fixo, qui conficitur methodo in propoſitione 6^a de Argento explicata.

17 Aurum ab aqua regia per Alcali fixum aut volatile dejectum, et leni calore ſiccatum, vocatur *Aurum fulminans*, eo quod ſive ab igne ſive affrictu incaleſcat, cum magno fragore in in auras diſſipatur: Hanc autem fulminandi vim, niſi Alcali volatile vel in confectione aquæ regiæ vel in præcipitatione adhibeatur, non acquirit.

18 Pondus Auri fulminantis majus eſt pondere auri ſoluti, parte circiter quarta.

19 Aurum fulminans cum diſplodatur, cavitates imprimit laminis metallicis non nimium craſſis quibus imponitur, vel quibus supernè premitur, et non deorſum tantum ſed quaquaverſum vires ſuas exerit.

20 Vis Elaſtica Auri fulminantis, dicitur eſſe ad vim elaſticam pulveris pyrii ut 64 : 1.

21 Aurum fulminans in Sphærâ ferreâ exactiſſime obturatâ incluſum, ac igni expoſitum non diſploditur; in ſimili caſu pulveris

pyrii facta eſt exploſio, et ſphæra ſimul diſrupta invenitur.

22 Aurum fulminans aqua ſæpius lavatum, cum oleo vitrioli tritum, cum ſulphure fuſum, vel ab alcali fixo lixatum vim ſuam fulminantem amittit.

23 Aurum nec per calcinationem cum vel ſine additione, nec per ſolutionem in aqua regia, nec per ſublimationem, nec per exploſionem, nec per ullam aliam methodum hucuſque repertam, in partes diſſimiles reſolvatur.

24 Aurum in aqua regia ſolutum cutem et plures ſubſtantias animales ac vegetabiles rubro vel purpureo colore tingit, debita facta evaporatione in cryſtallos concreſcit rubras, et quacunque methodo, metallico ſuo aſpectu ſit privatum, et ad pulveris ſpeciem redactum, colorem magis minuſve rubicundum plerumque adipiſcitur.

25 Aurum, metallorum denſiſſimum, cum vitro puro cryſtallino colliquifactione confuſum, vitri denſitatem adaugendo, aptum illud reddit ad reflectendos radios minime refrangibiles, et ſemper vitrum præbet rubro colore pellucidum.

26 Aurum a menſtruo ſuo extrahitur atque per aliquod tempus ſuſpenſum tenetur Oleis Eſſentialibus; facillime autem ſeparatur Æthere

re vitriolico, et cum unicum ſit metallum cui hæc proprietas competit, ſi cum cæteris vel minima quantitate commiſceatur, hoc indicio deprehendi poteſt.

27 Aurum in aqua regia ſolutum inde præcipitari poteſt (ſi multa aqua diluatur ſolutio) vel laminis Stanni, vel ſolutione Stanni in eodem menſtruo factâ, ſub forma pulveris coccinei qui vulgo vocatur *Caſſii purpureum Magiſterium.*

28 Una Auri ſolutionis guttula, per aliquot aquæ uncias diffuſa, Stanni interventu colorem purpureum toti aquæ conciliat, et ſic ab omnibus Subſtantiis metallicis quibus admiſceatur, facillime dignoſcatur.

29 Hepar Sulphuris cum Auro liquatum illud facile et adeo penitus diſſolvit, ut Aurum una cum Hepate filtrum permeans, in aqua ſuſpenſum maneat.

30 Aurum ab omnibus metallicis ſubſtantiis, Platina excepta, optime purgatur fuſione cum Antimonio; ab omnibus præter Argentum et Platinam cupellatione cum plumbo; ab Argento ſolutione in aqua regia; a Platina et minutis portiunculis cupri aliorumve metallorum quæ Catini cinericii vim haud raro effugiunt, per præcipitationem ab aqua regia interventu vitrioli viridis.

CAP. XV.

De Platina ſive Auro albo.

1 PLATINA eſt metallum perfectum, fixitate, ductilitate, et gravitate ſpecifica auro vix ſecunda; cæteris metallis in igne longe minus fuſilis, et ferro forſan excepto durior; colore argento obfuſcato ſimilis.

2 Platina, in igne vehementiſſimo quem furni et crucibula optima ſuſtinere poſſunt anteaquam in vitrum liqueſcunt, non funditur, ſed pondere aliquantulùm augmentatur: Hæc ponderis augmentatio, adhæſioni forſan ferri vel metalli cujuſlibet imperfecti, quod per calcinationem pondere augetur, referri debet.

3 Platina, radiis ſolaribus condenſatis in foco ſpeculi concavi cujus diameter æqualis erat 22 unciis et focalis diſtantia 28 unciis, expoſita ex parte in fumum erat acta, ex parte fuſa in corpus album, ſplendeſcens, admodum malleabile.

4 Platina non ſolvitur ab acido vitriolico aquoſo aut concentrato, frigido aut ebulliente; nec ab acido marino viâ aut humidâ aut ſiccâ; nec ab acido nitri communi aut fumante; nec a ſulphure communi, nec ab antimonio crudo,

et hinc ab omnibus ſubſtantiis metallicis, auro excepto, diſtinguitur.

5 Platina ab aqua regia et hepate ſulphuris, inſtar auri, diſſolvi poteſt.

6 Platina in aqua regia ſoluta eſt coloris aurei, aut fuſci in rubedinem vergentis, prout ſolutio eſt ex parte vel penitus ſaturata: Hæc ſolutio evaporatione concreſcit in cryſtallos rubentes; ſolidis animalium partibus, lamellis vel ſolutioni ſtanni colorem rubrum aut purpureum, lavatione aquæ haud eximendum, non impertit; a ſale ammoniaco ex parte præcipitatur Platina, ſed nec a vitriolo viridi, nec ab Alcali fixo minerali; ab Oleis eſſentialibus, Æthere vitriolico, aut Spiritu Vini rectificato a menſtruo ſuo non ſeparatur, et hinc ab ipſo auro diſtinguatur; minimaque hujus vel illius metalli portiuncula, in mixtura quavis metallica ex ambobus conflata, his præcipue ſimilibuſque indicibus facillime dignoſcatur.

7 Platina ab aqua regia per Alcali volatile præcipitata, exſiccata et igni expoſita non fulminat, et ſic etiam ab auro diſcrepat.

8 Platina a menſtruo ſuo præcipitata, cum vitro contuſo mixta, et igni violentiori per longum tempus expoſita, nec cum vitro fuſione conjungi, nec colorem ullum ei communicare videtur.

9 Platina cum omnibus ſubſtantiis metallicis per fuſionem coit: ſi cum Aurichalci pari pondere fundatur, maſſa conflabitur dura quidem et fragilis, quæ polituram eximiam ſuſcipit, et nitorem ſuum diu conſervat.

10 Platina cum Plumbo aut Biſmutho fuſa, et cupello ſubjecta, igne vix vehementiſſimo ab iſtis metallis, adeo penitus liberari poteſt, ut fiat malleabilis.

11 Aurum cum Platina colliquatum, fit durius et in igne ſimul minus fuſile, quod in mixtione ſua cum aliis metallis non evenit.

12 Mercurius qui majorem habet Affinitatem cum Auro et Argento quam cum Plumbo, habet etiam majorem cum Platina; ſed minorem cum Platina quam cum Auro.

13 Platina majorem habet Affinitatem cum plumbo quam cum ferro.

14 Platina Auri inſtar minorem habet Affinitatem cum aqua regia quam aut Zincum, aut Ferrum, aut Cuprum, aut Stannum, aut Argentum vivum.

FINIS.